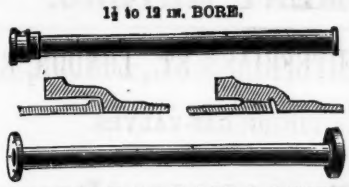
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXI. No. 1568.] LONDON, MAY 30, 1893. [45TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.



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INCANDESCENT GAS-LIGHT SYSTEM.

Consumes

4 cubic feet per hour.

Gives a light of

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Brilliant Light.

Perfectly Steady and

Noiseless.

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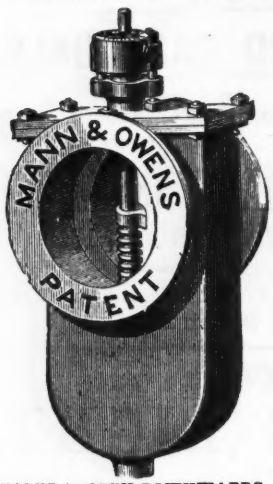

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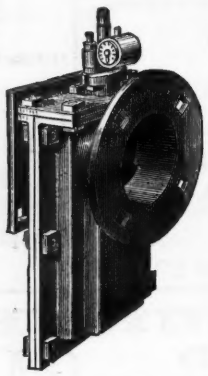

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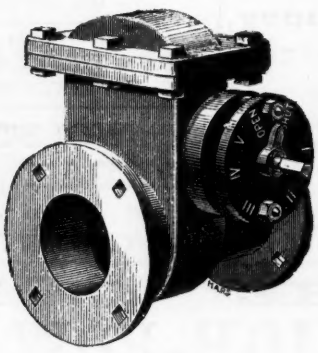

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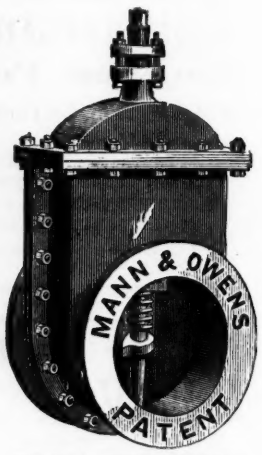

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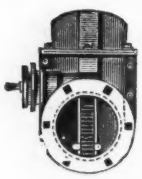

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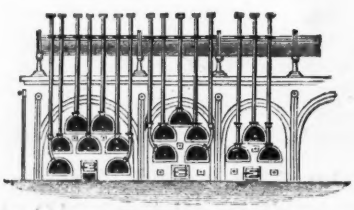

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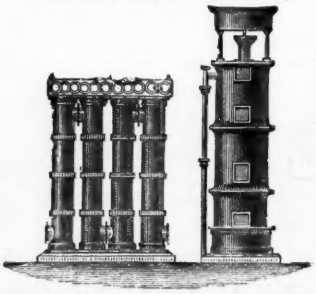

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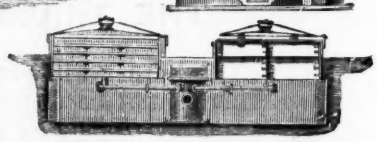

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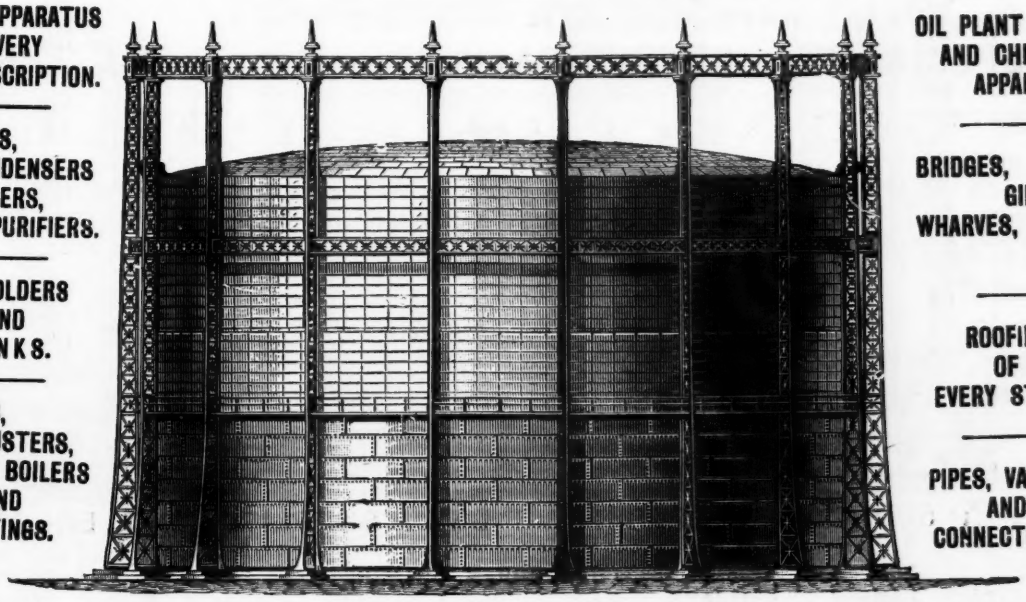

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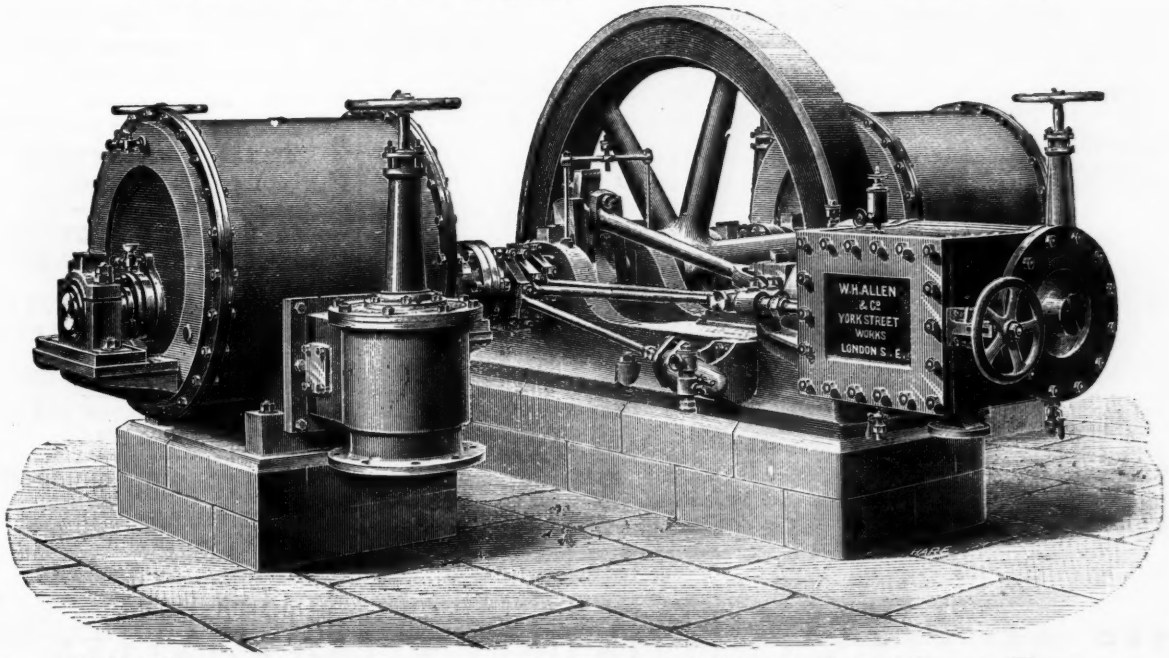

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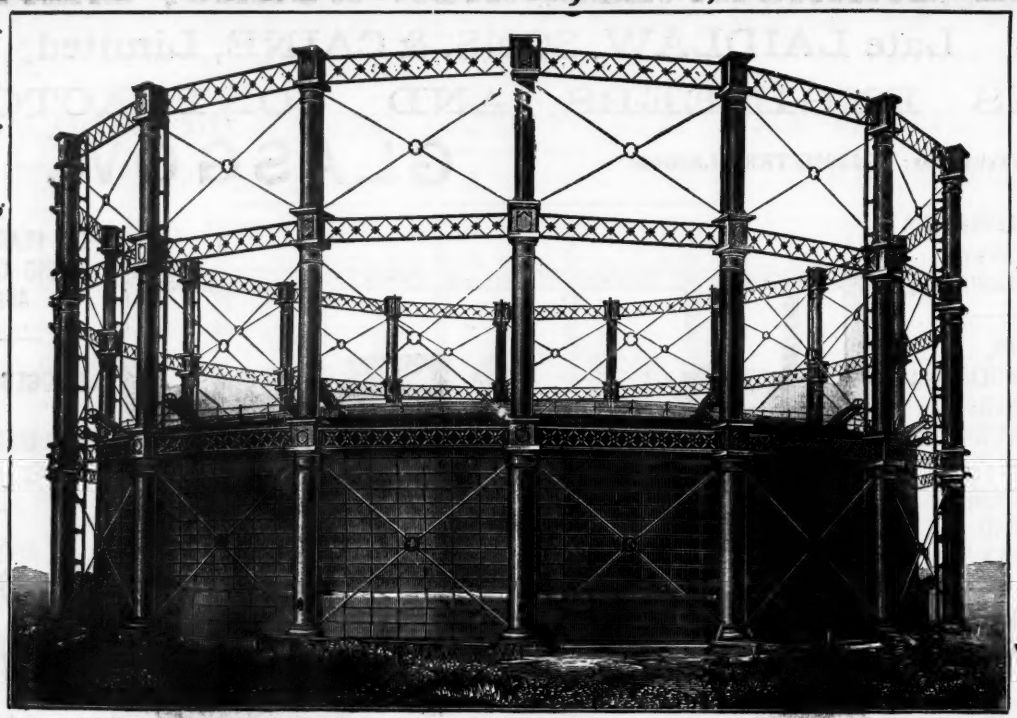

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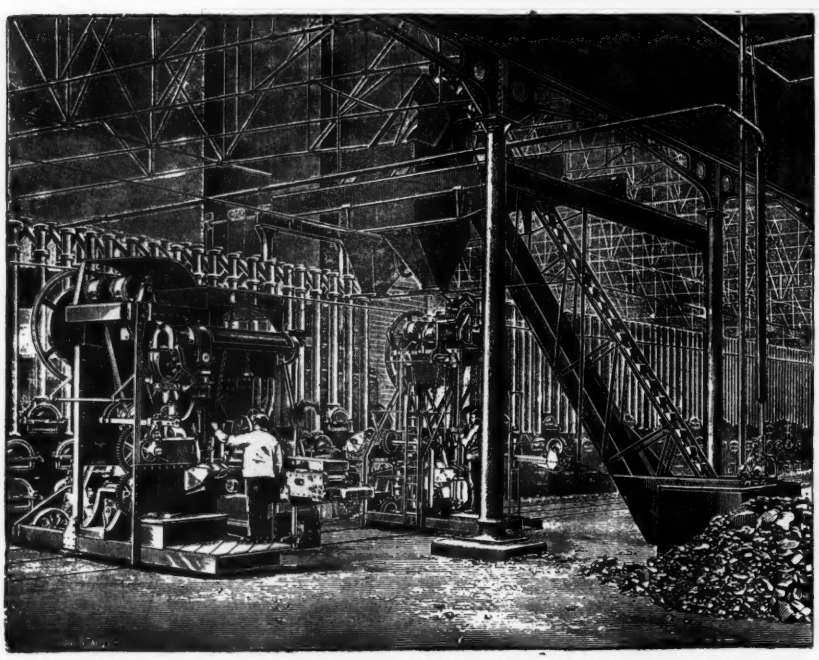
OVER **240** MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.



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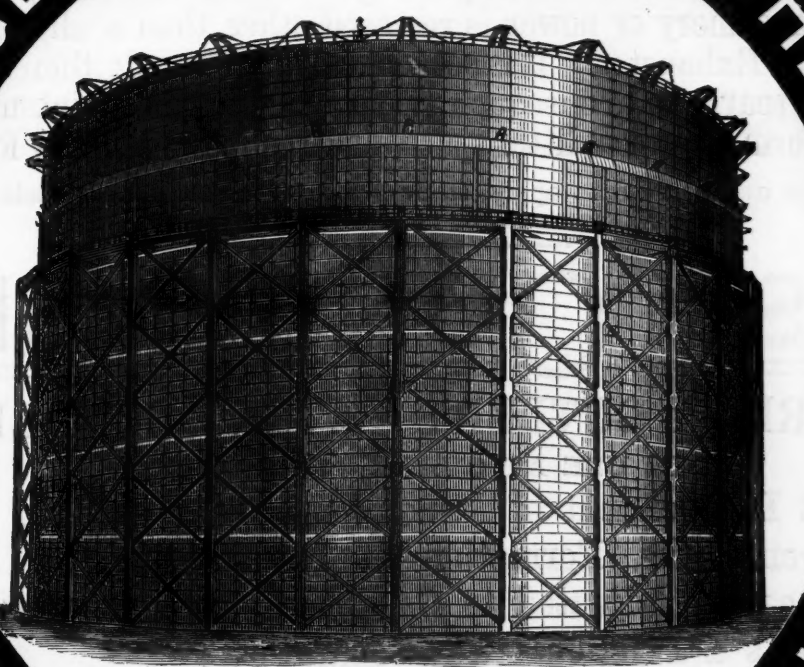

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By this Washer, which performs the functions of both a Washer and Scrubber, any tarry matters are intercepted, and the whole of the Ammonia is removed from the Gas, together with a high percentage of Carbonic Acid and Sulphuretted Hydrogen.

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The lower tiers perform the function of a most efficient Tar Extractor, removing from the Gas all traces of tarry matters.

The total back pressure due to this apparatus does not exceed about 7 ins.

The advantages claimed for the Washer are: **It is entirely automatic in action**, depending only upon a constant supply of clean water, proportionate in quantity to the volume of Gas passing. **It has no moving parts**, and thus **no driving machinery or power** is required other than a slight extra duty thrown on the Exhauster. **It is economical in first cost**; there is **practically no wear and tear**; and consequently **no expense for maintenance. It is compact in form, occupies little space, and requires no heavy foundations.**

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MORRIS & CUTLER'S PATENT CONDENSER

IS IN USE AT OVER 80 GAS-WORKS.

It is Independent of Atmospheric Temperature,
Prevents the Formation of Naphthaline,
Is Readily Adjusted to Condense varying makes of Gas,
Acts as a Frictional Tar-Separator,
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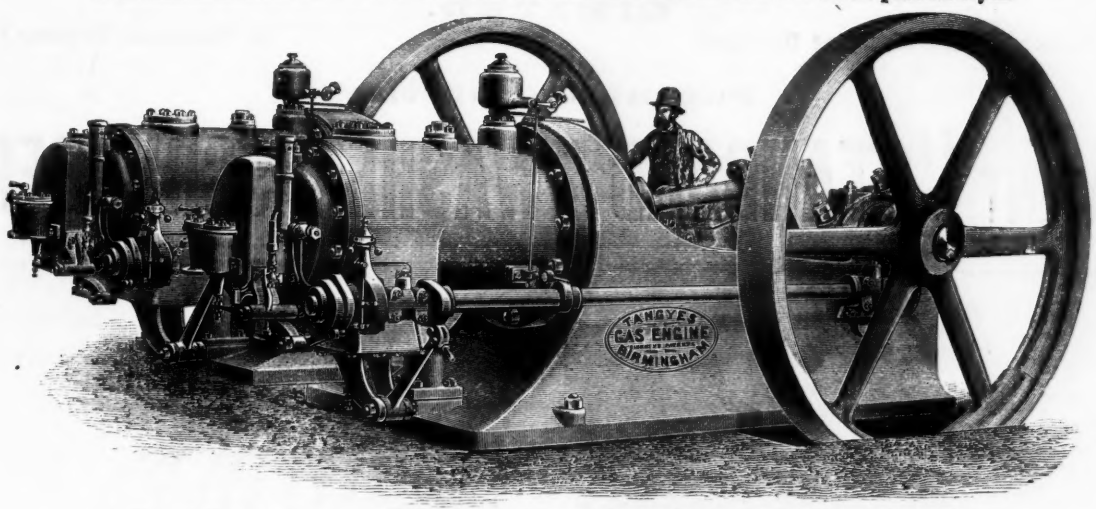
"OTTO" PRINCIPLE. PINKNEY'S PATENTS.

Messrs. Tangye have laid down special Plant and Tools for the manufacture of these Engines, and are able by their system of MULTIPLE MANUFACTURE and of WORKING TO GAUGE to turn them out in the best possible style.



The 70-H.P. (Nom.) Coupled Engine, giving 172 Actual H.P., and indicating 200 H.P.
Single Engines from ½ to 146 Actual H.P. (=170 Ind. H.P.) and Coupled Engines from 86 to 292 Actual H.P. (=340 Ind. H.P.)

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A Four-Lift Gasholder, nearly 200 feet high and 8 million cubic feet capacity, has been recently erected by us for The Gaslight and Coke Company, London.

PURIFYING MACHINES.

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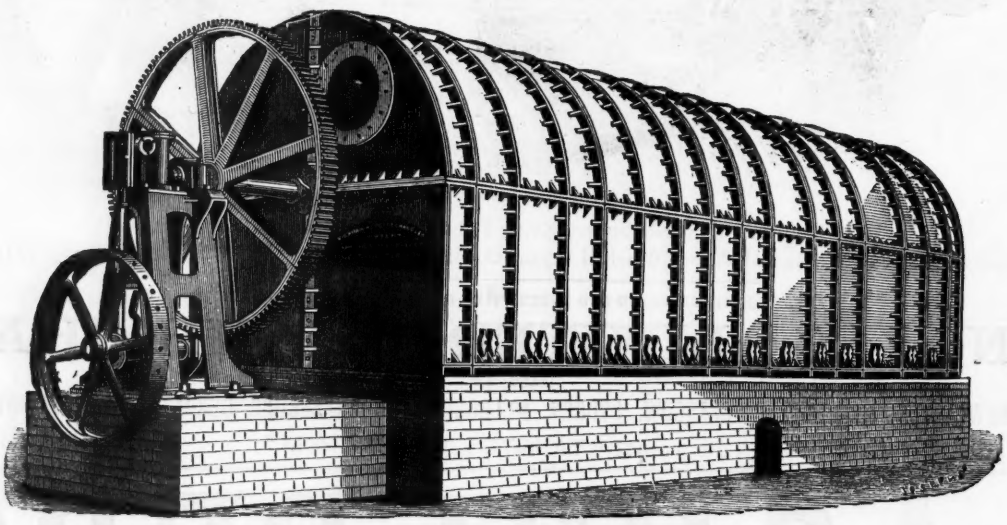
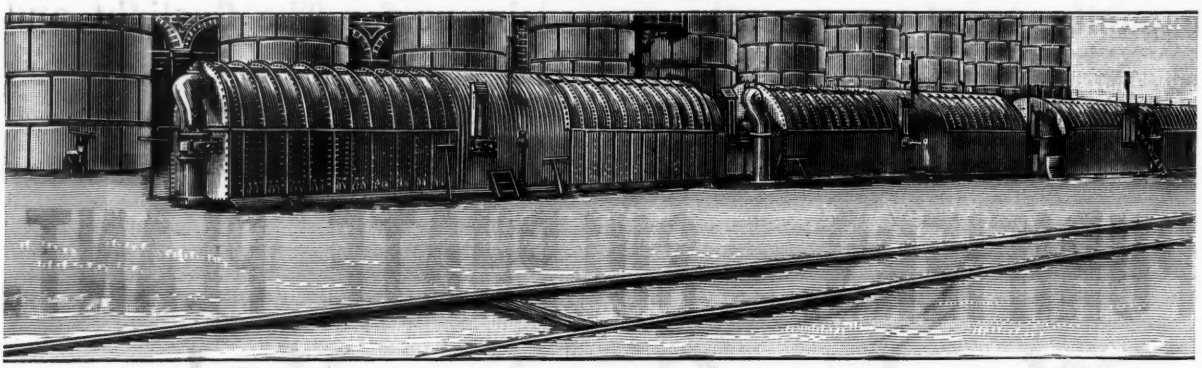
Patentees of the

PATENT "STANDARD" WASHER-SCRUBBER.



☞ **465 of these Machines (capable of dealing with 440,807,000 cubic feet of Gas daily) have been supplied, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen, from Coal Gas.**



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company; the Engines driving same being under Galvanized Iron Covers. Six additional Machines are now in use at these Works.

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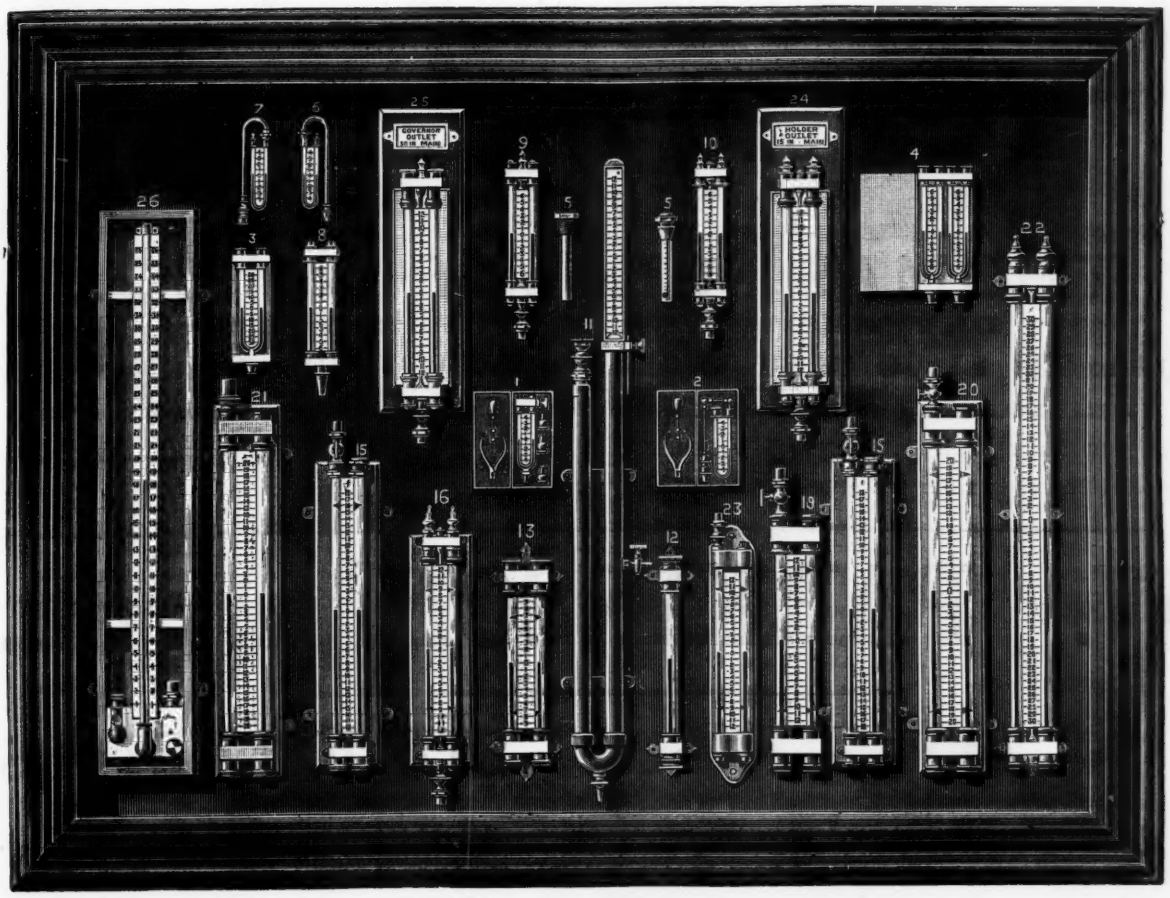

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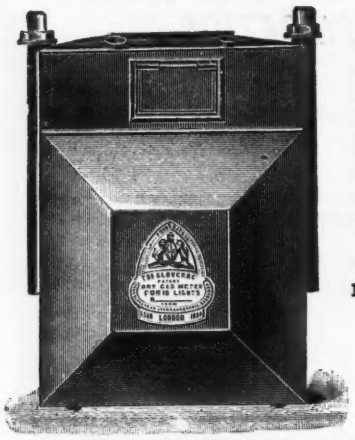

1st.—Are a remedy for all the defects of Wet Meters.
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4th.—Cannot become fixed by Frost, however severe
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7th.—May be fixed either above or below the level of the Lights.
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9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.
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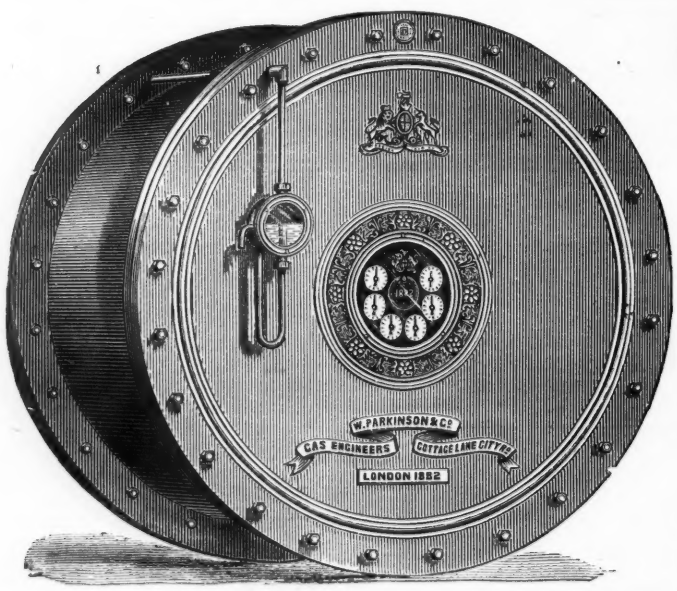

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IN

ROUND or SQUARE TANKS,

FITTED WITH PATENT

THREE-PARTITION DRUMS.

MORE THAN

300 STATION METERS,

Varying in size from **1200** to **200,000** cubic feet per hour, have been sold, fitted with

THREE-PARTITION DRUMS,

Since their introduction.

ROUND METERS as above are kept in Stock in all Sizes ready to send away at the shortest notice. Compact, portable, and very easily fixed. An Improved Overflow Water-line Regulator fitted to every Meter.

DURABILITY UNEQUALLED. SOME HAVE BEEN IN CONSTANT USE FOR OVER 60 YEARS.

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10, MAWSON'S CHAMBERS, DEANSGATE, **MANCHESTER.** Telegraphic: Address "PRECISON."

[See also Advt., p. 1024.

CONTENTS.

EDITORIAL NOTES:—

Gas, Lighting, &c.— PAGE

The Gas Institute in Belfast . . . 983
The Use of Tar for Carburetting Gas . . . 983
Chemists and Sulphur Purification . . . 984
Mr. J. T. Sheard on the Young and Bell Oil Gas Process . . . 984
Labour Topics for the Week . . . 985

Water and Sanitary Affairs—

Cutting Off the Supply of Water to an Inhabited House . . . 985
Birmingham Corporation Water Affairs—The New Scheme; The Secretaryship . . . 986

THE INCORPORATED INSTITUTION OF GAS ENGINEERS:—

General Meeting in London—

Discussions on the Papers (*concluded*)—
Mr. Belton's Paper on the Application of Oxygen to Lime Purification at Shrewsbury . . . 986
Messrs. Hood and Salamon's Paper on the Application of Weldon Mud to Gas Purification . . . 989
Papers by Messrs. Winstanley, Braidwood, and Carpenter on Working Inclined and Horizontal Retorts . . . 992

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market . . . 996
Electric Lighting Memoranda . . . 996
Dr. Anderson on Science and Engineering . . . 997
The Mathematics of Washers and Scrubbers . . . 998

NOTES:—

A New Opera Glass Photometer . . . 998
The Incandescent Lamp as a Standard of Light . . . 998
The Nature of Town Smoke . . . 998

COMMUNICATED ARTICLE:—

The Young Oil Gas Process, from a Southern Point of View. By John T. Sheard, F.C.S. . . . 999

TECHNICAL RECORD:—

Midland Association of Gas Managers . . . 1000
Southern District Association of Gas Engineers and Managers . . . 1000
Ohio (U.S.A.) Gaslight Association—Annual Meeting at Columbus . . . 1001

REGISTER OF PATENTS:—

Heating Gas-Retorts—Anderson, R. B. . . . 1003
Gas Motor Engines—Anderson, F. H. . . . 1003
Collecting Ammonia and Ammoniacal Salts from Gaseous and Liquid Mixtures—Cuyper, E. de . . . 1003
Prepayment Gas-Meters—Steele, J., and Brierley, J. W. . . . 1004
Station Gas-Governors—Hawkyard, J., and Braddock, J. . . . 1004
Patent Notices . . . 1004

CORRESPONDENCE:—

Oil or Water Gas *v.* Coal Gas . . . 1005
Electric Cooking and Heating . . . 1005

PARLIAMENTARY INTELLIGENCE:—

House of Commons Committee—Plymouth, Stonehouse, and Devonport Water Bills . . . 1006

MISCELLANEOUS:—

The Price and Quality of the Gas Supply in Manchester . . . 1007
West Bromwich Corporation Gas Undertaking—Annual Report . . . 1007
Stafford Corporation Gas Supply—Annual Report and Accounts . . . 1008
The Disposal of the Profits of the Huddersfield Corporation Gas-Works 1008
Wigan Corporation Gas Supply—The Working during the Year ending March 31 last . . . 1008
Bolton Corporation Gas Supply—The Past Year's Working . . . 1009
The World's Petroleum Supply . . . 1009
Notes from Scotland . . . 1010
Current Sales of Gas Products . . . 1011
Coal Trade Reports . . . 1011
Gas and Water Companies' Stock and Share List . . . 1011

PARAGRAPHS.—Professor Lewes's Gas Institution Paper: A Correction, 985—Natural Gas as Fuel, 985—Protective Clauses as to the Use of Electricity, 986—Automatic Retort-Houses at Middlesbrough and Hartlepool, 996—Mr. R. W. Newman, 997—Professor Smithells on the Structure of Flames, 1000—The Incorporated Association of Municipal and County Engineers, 1000—Japan as a Coal Supplier, 1000—Mr Francis H. Wood, 1002—Alleged Damage to the South Metropolitan Mammoth Holder, 1002—The Purchase of the Stourbridge Gas-Works by the Town Commissioners, 1002—Death of Professor W. Foster, 1002—Sales of Shares, 1005—Unlawfully Taking Water, 1005—Rochdale Corporation Gas-Works, 1005—Monte Video Gas Company, Limited, 1005—Weck Patent Centre-Valve, 1006—The Manchester Trades Council and Gas Contracts, 1006—Grafton (New South Wales) Gas Company, Limited, 1009—Exhibitions of Gas Appliances, 1010—Pernambuco Water Company, Limited, 1010—The East London Water Company and their Consumers, 1010—Cleckheaton Local Board Gas Undertaking, 1011—Suggested Reduction of the Quality of the Gas Supply at Leeds, 1011.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 30, 1893.

The Gas Institute Meeting in Belfast.

THE programme has now been issued of the business to be transacted at the approaching Belfast meeting of the Incorporated Gas Institute. The chair will be taken on the morning of the 13th prox., in the City Hall of Belfast, by the President, Mr. Denny Lane, M.A., of Cork, who will magnanimously cross the Boyne Water for this occasion, and will, we feel sure, be as magnanimously welcomed in the Ulster capital by the Lord Mayor and Corporation, supported by Mr. James Stelfox, the generally popular Engineer to the Belfast Gas Commissioners. It is not too much to say that this Belfast meeting has been already a cause of no little anxiety to the Council; and that trepidation has been felt in some quarters as to the success of the fixture—mainly, it is true, for the geographical reason which we expressed at the time the selection was made. The members of the Institute who last June shouted for Belfast, had little idea of the trouble they were bringing upon their Council, who have been devotedly acting up to their instructions, and doing everything possible to ensure the success of the meeting. As the time draws near, however, it is becoming increasingly evident that many private members of the Institute, having made inquiries into the matter, do not intend to go to Belfast after all. They may possibly have voted for the fixture; but that fact does not bind them to take the smallest trouble in order to swell the attendance or contribute to the interest of the proceedings. Unless, then, rumour is to be altogether discredited, the members of the Institute who will represent the organization in Belfast will come from a somewhat restricted area; and it is most desirable therefore that all who take a sincere interest in the Institute should make a determined effort to attend the meeting. The state of the case is rendered clear also by the list of papers, which is simply beggarly, exception being made of the professional element, as represented by Professor Vivian B. Lewes, Mr. E. Bryan Donkin, and Mr. J. Emerson Dowson, all of London. The first-named is an able and copious expositor; but it is hardly worth while going to the North of Ireland to hear him deliver a lecture and read a paper. It is merely making him supply a sequel to his Murdoch Lecture of last year; and although lecturing is a branch of Professor Lewes's "trade," it is questionable whether the Council have done wisely in depending so largely upon him for two years in succession. He is to lecture on "Gas Lighting and Ventilation," as well as read a paper on the "Enrichment of Coal Gas." Mr. E. Bryan Donkin is to discuss "Rotary Engines and their "Application for Gas Exhaustion"—not a particularly debateable subject; and Mr. Emerson Dowson's discourse will be on "Gas Power"—a proprietary subject. After these matters, there is nothing but two papers on "Gas-Fittings, and their Supply by Gas Undertakings," and on "Gas-Burners," by Mr. John Lyne, of Wexford, and Mr. Thomas Travers, of Cork, respectively—representing native talent; and a paper by Mr. David Terrace, of Middlesbrough, on the "Setting and Working of "Inclined Retorts" at his works.

If the technical portion of the Belfast programme is thin, there is not very much to be said for the remainder. The shipbuilding works of Messrs. Harland and Wolff will be thrown open for inspection on the Wednesday afternoon; and several other celebrated works are mentioned in connection with the meeting. The excursion will be the inevitable Giant's Causeway trip. No entertainment of any kind for an evening is spoken of; and we cannot but commiserate the Council upon having to ask their supporters to take so much trouble for the sake of the Institute, for so comparatively little promise of any reward. It is not the fault of the Council, of course, that the programme is so uninviting. The truth is that it would have taxed the resources of the Institute in its palmiest days to have made much of a Belfast meeting; and now—what with the incessant demand for papers for this and that technical society, and the organic weakness of the Institute, coinciding with one or two other depressing influences which need not be mentioned here—it will need careful handling to avoid a disaster.

It is very unpleasant to have to utter these unsavoury truths about the coming meeting; but the case is too glaring to be glozed over. By tremendous effort, and at considerable self-sacrifice, two or three men have kept the Institute going these two years past, and have even imparted more than pristine glitter to the meetings. They cannot keep on at it, however; and it looks somewhat as though, in deciding to try Belfast this year, the less considerate and responsible section of members have laid the proverbial "last straw" on the "camel's back."

The Use of Tar for Carburetting Gas.

THE letter of Mr. William Carr, which will be found in another column, upon the statements relating to carburetted water gas that were made public at the recent meeting of the Institution of Gas Engineers, is a very apposite and timely contribution to the discussion upon this highly important matter. It is indeed curious, when one comes to think of it, that there was no mention of carburetting gas by tar, by anybody who took part in the debate

on this occasion. Our correspondent shows, with a touch of mordant humour, that there is still something to be learnt from the doings at the Widnes Corporation Gas-Works, where the much-criticized Dinsmore process, or a modification of it, is credited by him with enabling gas from slack coal not only to be raised to something over 18-candle power, but also to be made and distributed "at a price not exceeding 11½d. per 1000 cubic feet." Well, we may at once admit that there is something that has remained up to now unexplained about the Widnes performance. It is equally remarkable, however, that these triumphs of carbonizing should have remained indigenous in that particular locality. Although Widnes may be described by Mr. W. Carr as a place situated "in the "remote fastnesses of South Lancashire," he must be well aware that, for some years, it was the goal of many pilgrimages, undertaken by earnest inquirers, who were actuated by the sole desire of learning what was being done there in the way of gas making, and how to do it for themselves. Is there a gas manager in the whole kingdom who would not like to be able to make 18-candle gas from "slack" costing 7s. or 8s. per ton delivered, and to send it out at a prime cost of 11½d. per 1000 cubic feet? It cannot be argued that Widnes has been overlooked, or its lesson neglected. What we have been unable to understand in this connection is the reason why such a good thing has not travelled farther. It is easy to say that "there must be something in it;" but what is the something? We have never from first to last questioned the absolute good faith of Mr. Isaac Carr, who has been working away down there through good and through evil report, silencing his critics at the last by the facts of his revenue accounts; and we believe that the coal gas maker ought to have a good friend in tar, if he could only make use of it as Mr. Isaac Carr seems able to do. There has been so much "dust raised" over the Dinsmore process, and the part played in its development and modification by Mr. Isaac Carr himself has been the theme of so much controversy, that after this lapse of time it is quite impossible for an outsider to know just what is the exact position of affairs. We trust that it is not doing the process an injustice to remark that the general opinion of it outside Widnes is that there has been no possibility of obtaining exact and comprehensive data —such as technicians can respect and rely upon—of what it does for the gas. Mr. Isaac Carr has his working accounts, it is true; but surely these ought to have their bases in analytical and comparative figures which might be expected to hold good for other places besides Widnes. Will Mr. William Carr—altogether apart from anything that has appeared in our pages or elsewhere—take the trouble to go afresh into the history of the Dinsmore process, and his brother's dealings with it, and tell the world the why, how, and wherefore of these occult results? We can promise him the fullest attention from water-gas specialists, as well as coal gas makers, if he can solve the riddle of tar carburetting.

Chemists and Sulphur Purification.

THERE has been some commotion among chemists who are interested in the subject of coal gas purification over the evidence given by Dr. Odling and Professor Vivian B. Lewes on the sulphur clauses of the Crystal Palace District Gas Company's Bill; and at the last meeting of the Manchester Section of the Society of Chemical Industry, Mr. R. F. Carpenter, Mr. G. E. Davis, and others made an onslaught on the position taken up by the eminent specialists in question. The gentlemen attacked are perfectly well able to take care of themselves in every controversy with their fellows; and we do not propose to defend them here. It is desirable, however, to set the matter in a proper light, from the point of view of the gas manufacturer. We are in favour of gas being sold as pure as it can be made by reasonable and practicable methods—holding that where the spirit of the sulphur clauses is grasped by the management of any gas-works, that works is likely to be administered creditably in other respects. Admitting this as a general principle of gas management is not the same thing as conceding that testing for sulphur in gas, and penalizing its occasional occurrence, should be conducted as by the London Gas Referees, or that the difference between 20 and 30 grains of sulphur in gas is likely to constitute an injury to its consumers. To admit the desirability of sulphur purification is one thing; to draw the line where the proportion of sulphur impurity shall be deemed a nuisance, and shall subject the gas manufacturer to a penalty, is another. There is no denying or getting over the fact that coal gas does contain sulphur; and this impurity is only reducible to an uncertain minimum by any means known to science. It is hard to see why an authority in chemistry should be "slated" by his compeers for saying that, in his opinion, the difference to the consumer between gas containing a certain proportion of sulphur admittedly higher than the possible minimum, and a certain still higher proportion, is inappreciable. The great point is that acceptance of the higher proportion nevertheless involves sulphur purification, and also that the figure has a legal rather than a technical meaning and bearing. The matter is of special interest to Manchester chemists, because they have been struggling for years in the interest of the public to convince the local Gas Committee of the propriety of sending out purer gas than their scheme of gas-works administration permits. Manchester gas is not purified from sulphur compounds at all, and not always from sulphuretted hydrogen. If the Manchester Corporation Gas Committee had the London Gas Referees to deal with, they would lose most of their profits in fines. They are so backward in this matter of purification, that Mr. Carpenter and his friends appear to dread their becoming acquainted with the recent chemical evidence on the Crystal Palace District Bill, lest they should be confirmed in their slovenliness by the argument "O! Dr. Odling says that 30 grains of sulphur do not "hurt; and as our gas only contains 40 grains or there-"abouts, there cannot be much to complain of. If the "difference between 20 and 30 grains is inappreciable, so "must be the difference between 30 and 40 grains." The argument is specious, and therefore likely to take with people who desire confirmation in the belief which it seems to support. It does not hold water, however, for the reason already adduced. Once let sulphur purification be adopted, and the average proportion of the impurity in the gas will be pretty much the same, whatever the limit at which the magistrates may be invoked. The gas manager does not try how little sulphur he is able to remove from his gas, but how much. He has no interest in letting the sulphur run up to within a measurable distance of the parliamentary limit. Indeed, some of the best work now being done in this line is the gratuitous service of gas managers who are under no statutory pains and penalties in regard to the matter. There is only one Manchester Gas Gommittee in England, though there may be a few obscure towns where the obligation to supply gas decently purified is similarly ignored.

Mr. J. T. Sheard on the Young and Bell Oil-Gas Process.

THE particular attention of readers of the JOURNAL is desired for the critical account by Mr. J. T. Sheard of the Young and Bell oil-gas process, which will be found in another column. The nature of the process itself is pretty well known to gas engineers by this time; and all that remains to be considered is the results. Mr. Sheard feels himself on sufficiently sure ground to generalize in chemist's language about what happens to the oil in the course of its treatment as at Peebles; and we are not disposed to follow him step by step in this theoretical exercise—being content to take his evidence for the efficiency and economy of gasifying oil at a low temperature, with washing and cooling of the product in the simple yet philosophical way applied by Messrs. Young and Bell. The most remarkable point of the process is the low cost of the illuminating unit produced by it. For the purpose of enrichment, Mr. Sheard calculates that the Young and Bell oil gas can be had at an average cost of somewhat less than ½d. per candle per 1000 cubic feet—a figure which compares most favourably with published estimates. Where enrichment only is desired, therefore, it would appear unnecessary for the present to look beyond the new oil gas—if indeed it is new, a point upon which we reserve all expression of opinion. It may be pointed out, however, that 90-candle gas, such as is the outcome of the Young and Bell process, is much "too bright and good, for human nature's daily "food." It is a veritable "pick-me-up," for application in what may almost be called homœopathic doses. It does not trench upon the domain of production, but leaves the burden of lifting the holders upon the retort, or it may be on the water gas generator. There is no reason why it should not be as useful for carburetting water gas (or "blue gas" as

it is termed) as for common coal gas, since it seems to get as high a luminous effect out of the oil carbonized as can be claimed for any "cracking" process carried on in a cupola. Turning to a minor question, but still an interesting one, we should like to hear what the Pintsch people think of the Peebles performance. At the first glance, it would strike one as likely to cut the ground from under the feet of the more familiar oil gas systems—that is, if the Young and Bell gas will stand compression. Nothing has been said upon this head; but the probability is the gas will endure this treatment as well as, if not better than, the description of gas at present used for portable work.

Labour Topics for the Week.

THERE is nothing more to be said about the Hull strike. It is over, and the strikers are in exactly the same position with regard to the question of freedom to labour as they were before, with the difference that they have tried their strength against the employers and have been worsted. The men have gained absolutely nothing by following the hare-brained counsels of Tillett and J. H. Wilson and the rest; and if the members of the New Unions all over the country do not begin to ask themselves "where the pull "comes in," in return for their weekly subscriptions, they are simpler than we deem them. Meanwhile, the attention of the fickle public has been drawn off from Hull to Brussels, where during the last week the fourth International Congress of Miners has been held. Delegates from England, France, Germany, and Austria attended the meeting, and discussed the eight-hours day, a universal strike, and other more or less academical topics—only to illustrate the hollowness of the idea of internationalism. Resolution after resolution was proposed and carried, and duly reported to the newspapers, which registered the deliberations of the Congress as gravely as though its declarations were something more than playing at Council. The English delegates, it appears, had everything their own way; and their sober behaviour, we learn, was in strong contrast to the frothiness of their Continental friends. But then the British miner has much less to do with the policeman than his highly regulated foreign compeer. He is not liable to be invited to change his place of residence whenever the executive Government choose to honour him with suspicion. It must be somewhat difficult, after one of these gatherings on foreign soil, for the English delegates to keep up the illusion that the British workman is the "slave" they describe him in their more fervid moments. Capable of improvement though it may be, the lot of the British miner is enviable in comparison with that of the foreigner; and when one learns that in Belgium there are still thousands of women and girls working underground for twelve and fourteen hours a day, it occurs to an observer that these Continental miners had better put their own houses in order according to the English standard, before wasting time and money over International meetings that can have no practical issue.

Professor Lewes's Gas Institution Paper: A Correction.—A correspondent calls attention to a transposition by the printers of two figures on p. 873 of our issue of the 16th inst., in the analysis of purified Lewes gas, contrasted with a similar analysis of Lowe gas. The third figure in the former analysis, unfortunately, is not correct; and it makes the various items total up to 127·00, instead of 100·00. The mistake is in giving the amount of the "unsaturated carbons, ethylene, &c.," as 41·21, instead of 14·21.

Natural Gas as Fuel.—An article in the *Iron Trade Review* gives the following dates in the development of natural gas as fuel: In 1821 the gas was first used for illumination at Fredonia (N. Y.); in 1838, for heating purposes at Findlay (O.); in 1841, for salt making at West Virginia; in 1860, for steam production at Oil Creek (Pa.); in 1870, for domestic fuel on the shore of Lake Erie; in 1873, for iron making at Leechburg (Pa.); in 1883, for plate glass manufacture at Creighton (Pa.); and in 1883, for general supply at Pittsburgh. In 1884, natural gas was discovered in large quantities at Findlay; and in 1886, in great quantity in Central Indiana. The amount of capital now invested in the distribution of gas from the various fields is estimated as equal to £20,000,000. The writer of the article holds that within the ten or fifteen years during which natural gas has been counted worthy of much consideration as a source of domestic and manufacturing fuel, it has grown to be of more importance as an element of profitable employment than petroleum; and though the supply is said to be failing in some localities, the Trenton limestone of Ohio and Indiana has been added to the Pennsylvania source of supply, and now the Clinton formation bids fair to afford another valuable source.

WATER AND SANITARY AFFAIRS.

THE peculiarly captious line of conduct adopted by many persons where they have to deal with a Water Company finds apt illustration in the appeal case argued before Justices Charles and Vaughan Williams, in the Queen's Bench Division, some ten days ago, and reported in the last issue of the JOURNAL. It is not always that we are able to express satisfaction with judicial decisions affecting Water Companies; but in this instance, at least, there is no reason to find fault with the result of the appeal. The only marvel is that it should have been thought justifiable (the Magistrate having decided in favour of the Company) to carry the case any farther. In one sense, however, it should be a source of satisfaction that it has been further argued and authoritatively decided, because henceforth there will be no excuse for any water consumer, however captious or prejudiced, seeking to place upon a fairly intelligible statute a construction which is altogether untenable and absurd. Section 48 of the Public Health (London) Act, 1891, enacted that an occupied house without a sufficient supply of water is to deemed a nuisance, and, as such, liable to be dealt with by the Sanitary Authority. By section 49 of the same Act, it is provided that, where a Water Company may lawfully cut off a supply to any inhabited dwelling-house for non-payment of water-rate or other cause, the Company shall, within 24 hours after exercising the said right, give notice thereof in writing to the Sanitary Authority of the district in which the house is situated; it being further declared that, for neglect of this provision, the Company shall be liable to a fine not exceeding £10, and that "it shall be "the duty of the Sanitary Authority to take proceedings "against any Company in default." Armed with this enactment, the Vestry of St. Mary, Battersea, took summary proceedings against the Southwark and Vauxhall Water-Works Company in December last under the following circumstances: According to the evidence, a leakage occurred at No. 79, Mallison Street, in the district of the Company—*i.e.*, there was a leak between the stopcock and the house. Of this the Company were informed; and they thereupon caused the stopcock to be shut down, a step which stopped the leak, and, also, of necessity, stopped the supply of water to No. 79. This stoppage continued for a period of some three weeks, at the expiration of which time, the fracture in the pipe having been repaired, the supply was at once renewed. It was admitted that the Company gave no notice to the Vestry; but they gave no notice because, as the event proves, it was not required. On the matter coming before the Magistrate, he held that it was a question of urgency, and that the stoppage in the supply need only have been one of mere temporary inconvenience, had the occupier pursued the rational course of communicating at once with his landlord. There was no pretence for suggesting that the Company intended to withdraw the supply of water from the premises, except for the obvious and immediate purpose of stopping the leak. This being so, the Magistrate was constrained to rule that the Company were quite right in point of law; and he, therefore, dismissed the summons, but without costs—the learned gentleman thinking, erroneously, that, having regard to the Act of Parliament, the Vestry had had no choice but to proceed.

Reasonable people would imagine the case might have ended there. Not so, however; the Vestry of St. Mary, preferred to contest the decision. Counsel, on their behalf, addressed a lengthy argument to the Judges of the Queen's Bench Division, which resulted, and could only result, in the dismissal of the appeal, with costs. It would, indeed, have been preposterous if the Act of 1891 could have been made effectual for punishing the Company as for a criminal offence, in view of the facts we have stated. Looking at the case broadly, it would seem idle to suggest that a criminal offence could be created (*i.e.*, imputed to the Company) merely because someone else (in this particular instance, the landlord) neglected to do what he ought to have done—viz., to remedy a leak and then turn on the tap. Apart from this, however, it is palpable that the section upon which the prosecution was based, could never have been intended to apply to a case of this sort. Our own view on the point was unhesitatingly adopted by Justice Charles and his learned colleague, who held it to be clear that a mere temporary cessation in the supply did not cast upon the Company the responsibility

of giving the notice contemplated by section 49 of the Act referred to. Moreover, the learned Judges pointed out that, whether the Company had cut off, or ceased to give, the supply, was mainly a question of fact, rather than of law; and, regarded in this light, there was nothing in the evidence which would have justified the Court in overruling the Magistrate's decision. The mere circumstance that there was some delay in repairing the leakage was irrelevant to the issue, because for that delay the Company were in no sense responsible. They were prepared to restore the supply directly the leak was repaired; but it was not for them to repair it. Not only so, it was proved that the Company's servants actually told the tenant that he had better communicate with the landlord at once, and get the pipe repaired. So that on every principle of law and reason, it must be held, and was held, that the Company were in the right and the Vestry in the wrong. In fact, the Vestry proceedings from first to last were misconceived and mistaken.

The Water Committee of the Birmingham Corporation are now fairly embarking upon a long-contemplated and laborious undertaking. Doubtless the discussion on their report, in last week's JOURNAL, will have been scanned with interest by many of our readers; and with no less interest will they follow the gradual execution of the Water Committee's programme. Of course, there were members of the Council who, upon certain details, "wanted to know, you know." But the Mayor refused to be drawn into what his Worship might have regarded as inexpedient disclosures; and, in the end, the resolution for the adoption of the Water Committee's report found general acceptance. It may perhaps be a question whether anything will be gained by the Mayor's reticence upon some of the points referred to. Little birds will whisper, with more or less heed to accuracy; and what an enquiring town councillor fails to learn in one quarter, he generally manages to ascertain in another. The result sometimes is that it is seen to have been a mistake to refuse to give information at head-quarters. In these days when financial scandals are not unknown, and when imputations of jobbery and favouritism are freely breathed in stage asides, it is probably wiser to be over-communicative than to excite question by an attitude of close reserve. Upon one point, however, no sensible individual will find fault with the Birmingham Water Committee. Rash suggestions to the contrary notwithstanding, they will do well in engineering matters to be guided by their Engineer's advice. Having regard to the nature of the work in hand, it would be nothing less than lunacy to give play to amateur ideas, or to undertake responsibility without the full support of competent professional counsel. Again, the Committee have done well to guard against the consequences of divided counsels or half-and-half responsibility by giving to each of the two Engineers selected for employment sole command in his own field of duties. Whether it may become necessary or expedient, as time goes on and the great scheme of bringing water from Wales approaches realization, to place a third Engineer in supreme command of the two to whom separate departments are, at all events at the present time, to be entrusted is a question which it would, perhaps, be premature to discuss. Incidentally, it is interesting, and, to a certain extent, rather painful to notice the number of candidates who applied for the post of Secretary to the Water Department. No less than 171 gentlemen entered the field of competition. But out of all this multitude there was only one candidate whose qualifications reached the ideal level of the Water Committee, and, rather than lose him, the Corporation under whose banner he at present serves, have made it worth his while to stay where he is. "It is "an ill wind which blows nobody any good;" and, in this instance, the breeze has been beneficial in bringing an increase of salary to the highly-qualified gentleman in question, and the vacant post at Birmingham to the next best man, who will doubtless be eager to prove his fitness for an office coveted by 169 unlucky competitors.

Protective Clauses as to the Use of Electricity.—A Joint Committee of the two Houses of Parliament will shortly have under consideration the question whether the grant of statutory powers to use electricity ought to be qualified by any prohibition or restriction as to earth return currents, or by any provisions as to leakage induction or similar matters; and, if so, in what cases and under what conditions.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, MAY 10 & 11, 1893.

Mr. JOHN METHVEN, Assoc.M.Inst.C.E., President.

DISCUSSIONS ON THE PAPERS.

We complete to-day our report of the proceedings at the above meeting, by giving the discussions on the remaining papers.

MR. BELTON'S PAPER ON THE APPLICATION OF OXYGEN TO LIME PURIFICATION AT SHREWSBURY.

Mr. C. C. CARPENTER (Vauxhall) remarked that the thanks of the Institution, and of gas men generally, were due to Mr. Belton for having for the first time put the oxygen question on its proper basis. The paper was not an *ex parte* statement at all; but a very clear description, in which the *pros* and *cons* of the system were very faithfully set out as applied at Shrewsbury. As far as he could gather, the system adopted was practically the same as that which was initiated by Mr. Laming with regard to oxide of iron. He suggested the use of oxide of iron with oxygen for the removal of sulphuretted hydrogen. The lime process at Shrewsbury was the same up to a certain point; the addition being the removal of the carbonic acid and the bisulphide of carbon. The principal reason which Mr. Belton gave for the adoption of the oxygen process was that in residential towns, where odours arising from gas-works had to go forth undiluted by those from other factories, noses were very sensitive. A great many of the gas-works in London were surrounded by residential property, in some cases of a high class; and yet it would be very difficult indeed for anyone not aware of the location of the works to know that gas manufacture and purification were being carried on there. The reason probably was that, in the works to which he alluded, the system of working lime in rotation, not by means of separate carbonate and sulphide vessels, was that usually adopted; and it was perfectly easy under these circumstances to bring out the lime in an innocuous state—perfectly free from smell. Another point made was with reference to the increase of illuminating power. It had been stated that this increase had been as much as 2 to 3 candles. But Mr. Belton put it at about 1½ candles; and he said this was not maintained in the winter, when, in fact, it altogether vanished. He also said that the increase of illuminating power was due to the heat set up in the purifiers. But further on he took credit in the cost of purification by oxygen for the saving in cannel, although he did not say to what exact amount; the total saving being 0·7d. It would be interesting to know how much credit he took for the increase in the illuminating power, especially seeing that it was not obtained at the time when it was most of all wanted—namely, in the winter. Further, if this great increase was obtained in the summer time by the heat in the purifiers, was there not always at hand waste heat from the chimney shafts and the engine exhausts, which might be used to increase the illuminating power of the gas, instead of making oxygen by the Brin process? Another point was the amount of lime used. Mr. Belton employed 47½ lbs. per ton of coal; and although this was much better than his previous result, it was very large compared with what was usual in London. His own figures worked out to about 34 lbs. Previously Mr. Belton had used 60¼ lbs. per ton; and there was no wonder (with such a quantity of lime) that a great nuisance resulted, because he must have taken the lime out of the boxes in a condition of sulphide of lime, which, as soon as it got into the air, began to smell. It would have been interesting to the members if Mr. Belton could have thrown some light on the comparative advantages of the air and oxygen processes. He said that, in some cases, so much oxygen was used that the carbonic acid got forward—a result brought about by the sulphuretted hydrogen being burnt up, when the carbonic acid would naturally go forward. This might be an explanation of some of the other difficulties with regard to Mr. Belton's purification. It would also be interesting to have a continuous record of the amount of oxygen

found on the inlet of the purifiers. He had recently had some correspondence on this subject with Mr. Hack, of Birmingham, who had at times found as much as nearly 2 per cent. of crude oxygen in his gas at the inlet to the purifiers. Under these circumstances sulphur purification by lime became impossible.

Mr. T. B. Ball (Rochdale) said he thought the most interesting point in the paper was the scientific accuracy which Mr. Belton stated he had obtained in the application of oxygen to gas purification. He (Mr. Ball) did not know whether or not he was the delinquent referred to, who put oxygen into gas without making any attempt at measuring it; but he still failed to see the advantage of measuring the quantity of oxygen so accurately when one had only about half enough for what was required. Mr. Belton had reduced to what he rightly termed a very delicate margin the limits within which oxygen was to be relied upon; saying that the percentage found most useful in the reduction of the sulphur compounds was not 0·1, but 0·09. He ventured to assert that there was not a gas-works in the kingdom where the percentage of oxygen in the gas could be determined to 0·01 per cent. Altogether apart from this, Mr. Belton did not appear to take any notice of the oxygen originally contained in the gas. As Mr. Carpenter had already stated, in Mr. Hack's experience this had been found to go as high as 2 per cent. No doubt this was an abnormal quantity; but many analyses of purified gas would be found where the quantity varied from 0·2 to 0·6 per cent.; and, in their own case, this had been exceeded in many instances. If the value of the process depended not only on the accurate adjustment within 0·1 per cent. to the value of the gas, but also had to be adjusted within these limits to the amount of oxygen originally present, and also to the varying quantities of sulphuretted hydrogen, which in Mr. Belton's case varied from 500 to 1200 grains, he was afraid this would constitute, in the minds of most gas managers, a very serious obstacle to the introduction of the process. The necessity, in that or any other process, of such careful analysis and such niceties of adjustment would be a serious obstacle to their introduction. It was stated in the paper that the full benefit to the illuminating power of the gas could not be obtained without an excess of oxygen. But it was likewise pointed out that any excess beyond 2 per cent. did not produce any further improvement, although various proportions were tried; showing that the gain in luminosity was not due entirely to the heat set up in the purifiers, or, on the other hand, to the excess of oxygen only, but that probably the heat liberated, or prevented the decomposition of, hydrocarbon compounds, for which the excess of oxygen acted as a permanent carrier. He failed to see on what basis this deduction was made, for there was always a permanent carrier present in the shape of hydrogen to the extent of nearly 50 per cent.; and this seemed to him to be quite as good as, if not a better carrier than, 0·01 of oxygen. At the close of the paper, it was stated that there had been freedom from nuisance, and constant and satisfactory purity of gas obtained, although there had not always been a sufficiency of oxygen. The satisfactory character of the purification seemed in one instance to depend on 0·01 per cent. in the adjustment of the oxygen; but in the other case this did not appear to be necessary. He could not quite reconcile these statements. The process was evidently dependent for any valuable results on the very narrow limits laid down being observed.

Mr. T. May (Richmond) desired to join in thanking Mr. Belton for having given them a plain account of his experience with this process. They had had previous statements put forward very different from this; and he was surprised, on looking through the paper, at the very small amount of gain claimed. Practically it was summed up in the fact that he had an increase in the illuminating power of his gas. Everything else could, he said, be done with air. This increase was derived from the heat in the purifiers. Some who used air were told that the quantity employed must lower the illuminating power of the gas; but Mr. Belton's experience was that the heat developed in the purifiers brought about a gain in luminosity. He pointed to this to show that, supposing this were correct, they obtained the gain when using air; but the inert nitrogen compensated for it. His experience in the use of air was that there was no loss in illuminating power. At the present time he was using about 3 per cent.; and, on lately testing some Newcastle coal, it gave good results—in one case 11,000 cubic feet of close upon 16-candle gas. If the quantity of air used did reduce the illuminating power, he thought they would have found it out. The quantity of lime employed at Shrewsbury seemed to him to be enormous; and he could not understand why so much was necessary. He used about 28 lbs. per ton of coal, as against Mr. Belton's 47½ lbs. That gentleman stated that he had four purifiers; but he (Mr. May) should like to know if he employed any oxide catch-boxes afterwards, or simply passed the gas through lime. If this were done, one could understand that it was necessary to change the purifiers frequently; and he would suggest that much higher results might be obtained by putting down some oxide catch-boxes. He should also like to ask Mr. Belton what he changed the vessels for. Some changed when the carbonic acid got forward; others changed for sulphuretted hydrogen and when the sulphur rose, which was the practice followed at Richmond.

Mr. C. E. Botley (Hastings) said he had for some years given a good deal of attention to the question of using oxygen for purification, as he was placed in a peculiar position. His works being surrounded by houses of a good class, it was incumbent upon him to do everything in his power to reduce to a minimum any nuisance that might arise. When first built, the gas-works were really in the country, and the town had come up to them; but, of course, this was no excuse, in point of law, for allowing a preventable nuisance. Although, theoretically, purification by means of oxygen appeared to be more correct, from his experience with air he had not been able to see that it possessed any great advantages over that system, while it added to the complications on a gas-works, which were already serious enough. He had not found any marked depreciation in illuminating power from the use of air; in fact, there was neither gain nor loss. He might say the Company were under the sulphur clauses; and the condition of the purifiers when emptied was practically inodorous. After lifting the covers, the oxygen of the air combined so rapidly that the contents were deodorized directly; and consequently no complaints of nuisance on this account were made. They used to have them when sulphide purification pure and simple was employed; but now they worked the purifiers on the rotary system—admitting air in varying proportion, according to their condition. They knew when the sulphur was taken up by the temperature; and it was regularly watched. The purifiers were tested right away through; and by following this indication carefully, they were able to keep the sulphur down to an average of about 12 grains for the year—the maximum allowed being 25 grains. They had but one failure in this respect, and that was owing to atmospheric conditions. The purifiers were entirely exposed; and, under the influence of a blizzard, the temperature fell so rapidly as to cause a reaction. This they overcame last winter by simply letting the exhaust steam from the engines into the lutes of the purifiers. By watching the temperature carefully, they avoided all difficulty. With regard to the quantity of lime used, he might say his average for the last five years was 43⅓ tons of coal purified for every yard of lime, or about 23 lbs. of lime to the ton of coal. Of course, there was a great difference in the quality of limes, as also of cannels. They used curly cannel to keep up the average of about 16-candle gas officially tested. This was something like 22 lbs. to the ton of Newcastle coal. The total cost of purification for the past few years had not exceeded, for materials and labour, ½d. per 1000 cubic feet of gas sold; and, unless some very great advantages beyond this could be shown to result from the oxygen process, he should not feel inclined to make any change. In reply to the President, he added that the cost of lime delivered at Hastings Station, was 7s. 2d. a yard; and they paid 1s. 6d. a yard extra for getting it into the works.

Mr. R. O. Paterson (Cheltenham) remarked that gas managers were evidently advancing considerably in their experience of this question, notably in reference to the quantity of lime required. Mr. Belton used 47½ lbs. per ton of coal with the pure oxygen process, and Mr. Botley was able to do with 23 lbs. with the air process; so that there was evidently something more to be learned before coming to a definite conclusion. He was personally much obliged to Mr. Belton for his very admirable paper; and he could not help thinking he had fully justified his position, so far as Shrewsbury was concerned. He

questioned very much the absolute accuracy of some of the figures given; but this was a matter which, perhaps, they were not able to discuss. He had obtained certain results with the oxygen process; and he was justified in putting them forward. The point he (Mr. Paterson) was most anxious to mention was this: The oxygen process was admittedly one for the diminution of nuisance upon a gas-works from the use of lime in the purifiers. This was the initial reason for introducing it; and there could be no doubt at all that, from this point of view, the process was very efficient. On the other hand, the air process was equally efficient in this direction; and what he wished to know was whether Mr. Belton had obtained anything to compensate him for the cost of manufacturing the oxygen. The gas was stated to be of about the same illuminating power as it was previous to the introduction of the oxygen process; and practically Mr. Belton was now apparently only in his former position, when using lime pure and simple. He had had the trouble of manufacturing oxygen, though it seemed to have cost him nothing; but if the small quantity of oxygen required could be obtained from the atmosphere without the cost of manufacture, he did not quite see that a strong case had been made out for oxygen. He maintained a certain increase of illuminating power; but he denied the oxygen the credit of it, because he said it was not a question of the oxygen being in the gas, but of the heat generated in the purifying material. But one could generate this heat with air also. Furthermore, it appeared that a slight excess of oxygen in the purifiers was injurious, so far as the removal of the sulphur compounds was concerned. If this were the case, did not air, with its dilute oxygen, offer a better means of arriving at this condition of heat in the purifiers than pure oxygen? What occurred to him was this: If Mr. Belton found that, by a small excess of oxygen, he absolutely drove the sulphur compounds forward in the gas, would not an advantage be obtained by a combination of the two processes—admitting a small quantity of air together with a very little oxygen?

Mr. Frank Livesey said it seemed to him first of all that, with reference to cost, there was practically nothing gained at Shrewsbury. Then came the question of illuminating power, which Mr. Belton said was obtained by the heat in the purifiers. But heat could be obtained by the air process, except in the winter time; and even then arrangements could be made for obtaining it. It did not seem to him that this contention had been proved; and they wanted the help of some chemists, and some experiments, to tell them more exactly what it was the heat did. He was told once by Mr. Harcourt that the removal of sulphur compounds was not due to the admission of air or oxygen, but to heat—that both these generated heat. The quality of the lime used in purification at different works had been much discussed; and he should like to know if Mr. Belton had had his lime analyzed. He believed the London County Council now had a contract that it should be 92 per cent. lime; and they would not accept it below 88 per cent. If care were taken, it was possible to ensure having lime up to 90 per cent., which made a considerable difference, especially when reckoning what had first of all to be paid for it, as well as for subsequently removing it. They were obliged to Mr. Belton for his paper, because it had put the oxygen matter before them in a clearer light than ever before; and it would certainly assist them all in coming to a decision. As to the gain claimed in illuminating power, he did not think Mr. Belton had quite proved his case.

Mr. J. Young (Hanley) thought the nature of the purification process required to be borne in mind. In the rotation system, they all knew it was necessary to keep the carbonic acid well behind the sulphuretted hydrogen. Comparisons were very difficult to make between gas produced from various coals, because the carbonic acid varied to a considerable extent. He said he had had some experience with North Staffordshire coal, in which the percentage of this impurity was very high; and there were as many as 900 grains of sulphuretted hydrogen and 1500 grains of carbonic acid present in the scrubbed gas. He should like to know if Mr. Belton had found that the oxygen process had in any way enabled him to get more work out of his lime than previously for the purpose of extracting carbonic acid. Judging from the figures given, it looked rather like it; and if it had this effect, it would be useful. The great point, it seemed to him, was that the carbonic acid had to be kept back; and it must be much easier to purify when the proportions of this impurity and sulphuretted hydrogen were different from those he had mentioned—viz., 1500 and 900 grains respectively.

The President said there was no doubt that the system of air purification was a very simple and perfect one. He had not had the opportunity of using oxygen; and if he had, he thought he should have rather hesitated to adopt it, for the simple reason that he was perfectly satisfied with the percentage of oxygen he obtained in the small quantity of air he had been in the habit of using. He preferred to take the oxygen in this way with the atmosphere, as he considered it did its work more effectually. The quantity to be dealt with was larger; and there was no necessity to measure the volume to the second decimal place. The operation of the air in the purifiers was a very interesting one; and he had never yet found it fail. It was easy to regulate the position of the different impurities. If too much air was taken in, it would be found that its oxidizing influence on the sulphuretted hydrogen was too great; and the difference in the position of the carbonic acid and the sulphuretted hydrogen would alter. If the former were found overlapping the latter, trouble would result; but, if the progress of the carbonic acid were carefully watched, one could, by altering to a small extent the percentage of air, obtain the desired result. With regard to the quantity of lime necessary, no doubt the whole explanation of this would be found in the quality of the material available. In some districts, the lime sent in for purification was very inferior. It was not in every place that one could obtain the same quality of lime as in London. That which came from the Medway district in particular was of very excellent quality; and, being burnt in a special way, and properly prepared, it was a very valuable material to use. He regretted that Dr. Thorne, who had taken considerable interest in oxygen purification, was unable to be with them, as he (the President) would have been glad to hear his remarks upon it.

Mr. Belton, in reply, said he did not come forward as the champion or the advocate of the oxygen process. He had simply given a narrative of his own experience, fairly free, he hoped, from any bias one way or the other. He could scarcely, therefore, be considered in the position of having a case to prove. It was said that there was no gain in illuminating power in the winter time; but this was not quite so. He had pointed out that, in previous years, when not using oxygen, they had a series of very mild winters. But the two during which they did employ it were exceptionally severe; and they were much more troubled by frost than people would be farther south—in fact, it was a matter of great difficulty to keep the works going without a liberal use of steam in every direction. During the winter of 1891-2, and several times last winter, the thermometer was nearly down to zero; and those conditions were not very favourable to gas making, or to the retention of illuminating power. Under these circumstances, the statement that he used nearly as much cannel showed that there still was a gain in the winter time; because, if he had been under the old conditions, he must have employed a considerably larger quantity to keep up the illuminating power of the gas, especially considering also that, since the oxygen process was adopted, he had been carbonizing an inferior class of coal. The gain in cost was calculated as the difference in the expense of cannel and coal. In his case, it was 4s. a ton. His experience was that the heat set up in the purifiers was pretty much the same in winter as in summer; and they found a considerable advantage during the last two winters by not having to keep the steam-pipe constantly going in the lutes—showing that the heat set up by the oxygen was not withdrawn during the cold weather. With regard to the quantity of lime used, the President had rather anticipated his remarks on this question. They had a very indifferent lime, and also a difficult coal to purify. Gentlemen who used north country coal and south country lime had a very good time of it; and he should be very pleased indeed if he could have the same conditions to work under. Unfortunately, he was obliged to use local lime, which was very inferior in quality, but a great deal cheaper than if they went a long distance for it, and had to pay heavy railway carriage. Mr. Young had pretty well stated the nature of the coal. During the whole year, they had averaged upwards of 1200 grains of sulphur; and that gentleman's estimate of the carbonic acid was fairly moderate, for on

two or three occasions it had exceeded 1500 grains. Taking these circumstances into consideration, the quantity of lime employed was not so very large for the work it had to do. At any rate, they had been using the same lime with inferior coal, and still had a gain of something like 22½ per cent. in the lime; and it seemed to him that these conditions would apply to any other works. If gentlemen were able now to complete their purification with 23 lbs. of lime, they might, by adopting the oxygen process, obtain a proportionate reduction. He might relieve Mr. Ball's mind of the idea that he intended any personal reference to him. It was rather to experimental work, not to an installation of the oxygen process. He had not kept any record of the free oxygen in the gas. His was only a small Company; and he had not the facilities or the staff for making the numerous tests and records he should like, in order to be strictly accurate and scientific in working. He might, however, say that, whatever the free oxygen might have been, it had not affected the working in any case, unless it was on the two or three occasions in which the carbonic acid overtook the sulphur. Since he made a reduction in the quantity of oxygen used about twelve months ago, he had never had this happen. The results given in his paper were not brought forward as a standard; they were simply the results of experience. A great deal had been made of the question of adjustment; but this was really a very small matter indeed. He could not see that it was anything more than must be required for the air process. Even with that, one had to be careful not to put in too much; and, if an insufficient quantity were put in, the sulphur would not be oxidized. Certainly, the hydrogen in the gas must act as a carrier; but he was not sure it would so act in the case he referred to, as regards oxygen. If it did, it would rather tend to show that there should be no deposition of hydrocarbon compounds in the purifiers. But he thought it was pretty certain there was, and that they were liberated by the effect of the heat. Heat was set up by the air process also; and if hydrogen acted as a permanent carrier for these liberated hydrocarbon compounds, the air process ought to show a gain in illuminating power, which at present it did not.

Mr. May remarked that the nitrogen might compensate for that.

Mr. Belton said no doubt many gentlemen had found the air process very satisfactory; but he would ask them how they would like to use it under the conditions of 1200 or 1300 grains of sulphur, where, to be effective at all, 6 per cent. of air would have to be admitted. He should not like to introduce this quantity of air himself; and he did not think there were many engineers who would. He did not have any oxide catch-boxes. With their very confined space, they had been compelled to dispense with the use of oxide. Where the purifiers were worked in sequence, as in their case, the change must necessarily be made for sulphuretted hydrogen. As a matter of fact, he always changed soon after this impurity showed at the outlet of the third box. One gentleman had spoken about the satisfactory result of reducing the sulphur compounds to 12 grains; but if he (Mr. Belton) allowed as much as this to go out, he would have a letter the next day from the Corporation. Although their statutory limit was 20 grains, they never failed to get a remonstrance if the sulphur compounds went up to 12 grains. The 7·15 grains he had mentioned as the average of ten months' working with North Staffordshire coal did not by any means represent the lowest point to which he had been able to reduce these compounds. He found that during the three weeks about Christmas, when the make was heaviest, they never exceeded 6 grains. The whole thing turned upon the quality of the lime and the quality of the coal. The fact that they had been able to use a lower class coal seemed to have been rather overlooked in the discussion; and another important point was that their cannel was inferior. They could not get at Shrewsbury a good cannel, such as curly, without paying a very high price for it, owing to their distance from the cannel-fields. They were obliged to use what they could get from the Midland district, which was comparatively inferior.

Mr. Carpenter asked leave to put a further question to Mr. Belton. It was stated that the total expense of the process, taking credit for a saving in cannel, was 0·7d. per 1000 cubic feet of gas sold. How much, he asked, would have to be added to this if no credit were taken for the reduction in cannel?

Mr. Belton said he could not give the exact figure then; but the saving was 4s. a ton on the quantity of cannel economized. It was the difference between the cost of cannel and that of coal. He could reassure Mr. Paterson with regard to the figures. They were actually taken from the working accounts; and he (Mr. Belton) was prepared to vouch for their accuracy.

Paper by Dr. J. J. Hood and Mr. A. Gordon Salamon on the Application of Weldon Mud to Gas Purification.

Mr. Carpenter said he thought it was necessary to the appreciation of this paper to bear in mind the distinction between the process known as the sulphide system and that known as the rotation system. He drew a rough diagram on the board to illustrate the point that the sulphide process consisted in the removal of the carbonic acid in the first vessel, bisulphide of carbon in the third, and traces of sulphuretted hydrogen in the fourth—with the interposition of the oxide of iron vessel in the second position. This system was first advocated by Mr. Harry Jones; and it was found necessary to keep a large volume of sulphuretted hydrogen driven forward through the carbonate vessels out of the sulphide purifiers. The disadvantage of the system of purification as then practised was the large number of vessels required. He had only shown eight purifiers on the board; but, as a matter of fact, the process was worked for a long time, and still was in some places, with ten. The use of Weldon Mud in a position of this kind would be impossible, because it was susceptible to the action of carbonic acid. Therefore the authors had experimented to see if there was anything in the interposition of oxide of iron or a material which would take up sulphuretted hydrogen from the sulphide boxes. The result proved that it was possible to pass considerable volumes of sulphuretted hydrogen into the sulphide boxes without impairing their efficiency; so that the process of sulphide purification became in their hands as simple as the rotation process. No more boxes were required for the removal of bisulphide of carbon, using separate carbonate and separate bisulphide vessels, than were required in the ordinary system. It was important to bear this in mind, having reference to the investigations the authors had been making, which might not be perfectly clear but for this explanation. Another interesting point as regards the working of Weldon Mud in the catch-vessels was the disadvantage (admitted by the authors) of the sloppy condition into which the materials got when worked in this position. Last year he suggested the use of oil in the lutes of the purifiers in a thin stratum—about 10 gallons of oil was enough for most purifiers. The effect of this was to improve the efficacy of the lute, and prevent the evaporation of moisture to a considerable degree. The sloppiness, being almost wholly due to moisture driven off from the lutes, quite disappeared; and it was possible to bring the material out of the boxes in a dry condition fit for revivification. Another point which had not been touched upon in the paper was this, and it would have been more correctly raised perhaps on the previous paper—namely, the necessity of oxygen in sulphur purification. He related last year the experiments he had made some time previously with reference to the necessity for the presence of oxygen to complete sulphur purification. They were under conditions in which it was not found possible to produce an active sulphide by passing the crude gas into clean lime. A small experimental scrubber, in which clean water was used, was interposed, and active sulphide was formed immediately. But the curious part about it was that, when the water was pumped over again, and passed into similar clean vessels, it was impossible then to produce the active sulphide. When the water was boiled and used in the scrubber, it was equally ineffective. His contention was that this showed that a trace of oxygen in the water in the experimental scrubber was sufficient to start the action, and permit the sulphide purifier being made.

Mr. T. B. Ball (Rochdale) asked to what extent the material referred to could be sulphided, and if it could be saturated at one operation—that was to say, whether it could be kept in the purifiers till it was saturated with the sulphur, and whether it remained long active. Another point he had some doubt about was as to the possibility of dealing with the carbonic acid in two boxes; in other words, whether one could so far eliminate it with two

boxes as to prevent the breaking up of those tender sulphides which were formed when hot lime was used.

Mr. C. GANDON (Lower Sydenham) said he understood Mr. Carpenter to say that it was necessary that the gas should be free from carbonic acid if Weldon Mud were used.

The PRESIDENT stated that this was so. The material had a natural affinity for carbonic acid, and therefore it was necessary to keep this away from it.

Mr. T. MAY (Richmond) asked if air was used at Beckton before Weldon Mud was introduced. They were told, he said, that a certain percentage of air was passed in with the gas when using this material, with certain results; but he should like to know if air had been previously employed with the oxide. Another matter deserving of some notice was this: "It would, therefore, appear to be desirable that the gas and the material through which it is passed should be maintained as nearly as possible at the same temperature, and that the gas should be saturated with moisture at its temperature prior to such introduction." If they did this, he was afraid it would favour the formation of naphthalene in the after part of the plant. If the lime process of the authors came into use, it would make the storeage of lime a rather difficult matter, because it would be necessary to keep it in an unslaked condition, and this would necessitate the deliveries being made with absolute certainty, which he need hardly say was not easy of accomplishment.

Mr. J. F. BELL (Stafford) asked the value of the Weldon Mud and the other material when spent. He said that, when oxide of iron was used for purification, the value of the spent material was considerable if it was near to a works where it could be burnt for sulphuric acid. No figures were given in the paper as to the probable value of the spent materials.

Mr. R. O. PATERSON (Cheltenham) said he gathered from the paper that the Weldon Mud was to be used chiefly for the purpose of recovering the sulphur from the gas; and, if this were so, it rather restricted its use. He was hoping they would have had such information as would point to a substitute for other purifying materials. Of course, they knew they could not obtain a readier or cheaper material than lime for the absorption of carbonic acid; but he was rather expecting they would have had a process brought before them which would supply a material to do the whole of the after-purification of gas with greater facility and less cost than the one now employed, and with an absence of the everlasting nuisance question arising from it. A point had been mentioned by Mr. Carpenter which did not exactly arise on the paper. It was not at all clear, nor did it seem proved, that the purification of gas from bisulphide of carbon was absolutely dependent on the use of oxygen in lime purifiers.

Mr. CARPENTER said this was his belief.

The PRESIDENT remarked that he did not think the authors of the paper would accept that.

Mr. PATERSON said he did not accept it either. He was employing lime entirely, and was obliged to do so to keep down the sulphur compounds. He was not using oxygen, from either the atmosphere or any other source. Of course, he had some oxygen in the crude gas, just the same as other people had; but it was not intentionally admitted. He was not making a point for the purpose of argument; but he wanted to know if there was any real proof that oxygen was an absolute necessity in a lime purifier to secure the absorption of the bisulphide of carbon.

Mr. CARPENTER said he might perhaps be permitted to give some explanation of what he had stated, though possibly Mr. Braidwood would be able to do it in better words. The works of which he was Engineer were now provided with anti-dips; and there was always a pressure above the atmosphere right up to the hydraulic main. It was impossible, when he was there, and he believed also under Mr. Braidwood's superintendence, to make sulphide in the lime boxes. Under those conditions, carbonic acid was taken out in the carbonate vessel. The sulphuretted hydrogen passed into the sulphide vessel; and the effective sulphide, for the removal of bisulphide of carbon, was not formed. The only way to get the sulphide formed was to take the material out of the purifier, expose it to air, and put it in again, when it at once became effective; or, as Mr. Braidwood had once done, either make the conditions similar to those operative in most gas-works, or draw in a small percentage of air.

Mr. PATERSON said he also was working with what were popularly called anti-dips. He had no hydraulic main at all, but simply a throttle-valve on the top of the ascension-pipe. He had pressure on the whole plant right back from the exhauster to the retort; and he had formed sulphide in his purifiers, and effectively purified the gas from sulphur compounds.

The PRESIDENT asked if he was equally fortunate in carbonating the lime under these circumstances.

Mr. PATERSON said he was; but he kept a series of four carbonic acid purifiers in advance.

Mr. W. BELTON (Shrewsbury) remarked that nothing had been said about the character of the gas with which the experiments had been made. He should like to hear what were the proportions of carbonic acid, sulphuretted hydrogen, and bisulphide of carbon in the gas; also what would be the likely effect of a considerable variation in its composition.

Mr. J. CASH (Brighton) said that, although only a visitor, he might be permitted to make a few remarks, as his name had been mentioned in connection with the use of this process at the Portslade works of the Brighton and Hove Gas Company. He was perfectly satisfied with the action of Weldon Mud in the use to which he had put it in the catch or outlet purifiers. Figures had been given by the authors of the paper as to the amount of duty these purifiers had done; but there was something they had not mentioned in connection with it, and this was the peculiar power which Weldon Mud had shown for the absolute absorption of sulphuretted hydrogen. Many present would possibly be familiar with the fact that, although the gas might pass the ordinary tests specified by the Gas Referees, by prolonged exposure the acetate of lead paper, especially in the summer, showed a slight discoloration (say) within twelve or fifteen hours. Since he had used Weldon Mud, he had found he could expose a test-paper for an unlimited time at the outlet of the gasholder. He had in his possession a test-paper which had been exposed for 60 days, and was as clean now as when it was put in. They were using only one catch-purifier on each section, instead of two as they did formerly when oxide of iron was employed. There was another advantage—namely, that the material, when thoroughly saturated and foul, came out of the boxes comparatively inodorous. He mentioned this because, when lime was partially fouled in a position of that kind, it was exceedingly offensive, as it could not be carbonated. With regard to the other process to which the authors had alluded—the hot lime process—this was one of the most interesting features he had seen in connection with modern gas purification. What its ultimate practical value might be, remained to be proved; but, in this experimental stage, he had not seen anything which had given greater promise with regard to its efficiency for the removal of bisulphide of carbon than the action of a hot lime sulphide prepared in the way the authors suggested. He wished them every success, because, if they achieved what they proposed, the number of vessels required for complete purification on a gas-works would be not more than half what were at present used. In the new section of the Portslade works, which were nearly complete, and were designed for the production of 3 million cubic feet of gas in 24 hours, they had only provided six purifiers. They now used eight in one section, and nine in the other. They hoped, with these six, to be successful in reducing the sulphur to the normal limit. If they were not, they would, of course, have to increase the number.

Mr. T. S. LACEY (Pimlico) said he was at Beckton when the initial experiments were made with Weldon Mud; and he had personal knowledge of the process employed there, which was rather different from that in use at other works. They found one thing at Beckton which they did not find at other stations, and this was that it was absolutely necessary to have lime in the catch boxes, as they did not use air. They could not purify the gas from the small traces of sulphuretted hydrogen sufficiently to enable it to be sent into the district. It was always a matter of surprise to him that other people could use oxide of iron successfully in their catch vessels, while at Beckton they could not. It had been tried; and they had to get it out in a great hurry, because the gas was passing in a comparatively very foul condition. He was now at a station where air was employed; and he must acknowledge that the same difficulty did not arise at all. The air was with the lime; and oxide of iron catch purifiers were used,

and seemed to answer very satisfactorily—in fact, they behaved in an entirely different way from those at Beckton. There must be some reason for this. When the lime came out of the catch purifiers, it was often apparently as clean as when it went in. No traces of sulphuretted hydrogen could be detected in it; and it was very difficult to get any out of it by the ordinary chemical tests. The conclusion he had arrived at was this: The gas contained a trace of ammonia, and also bisulphide of carbon, right away through to the end of the series. Provided the ammonia was present, even if well within the limits (because they were entitled to have a certain quantity in the gas), the result was that it and the bisulphide of carbon reacted on one another, forming sulphuretted hydrogen. This reaction took place in a very sluggish manner, and went on through the lime purifier from the bottom right up to the top. The consequence was that small traces of sulphuretted hydrogen were being continually formed as the gas passed through the vessels; and in summer they found they had considerable difficulty, even with lime vessels, in picking up these small traces. The vessels were exposed to the air and sun; and when the sun was very hot, they could not prevent the gas from getting foul. When they took out the lime, it appeared quite clean, yet it did not stop the sulphuretted hydrogen. They then thought of the device of putting water on the covers; and when they did this, and kept the top rather cool, the test was clean. That fact pointed, he thought, conclusively to this: At the temperature to which the cover was exposed—the gas, after it had gone through the lime, being subjected to this temperature—the ammonia and bisulphide of carbon reacted, and formed sulphuretted hydrogen, after the gas had gone through the whole of the purifiers; the result being that it was thus made dirty once more. Of course, this might occur again after the gas had been put into the holder perfectly clean; for, if the bisulphide of carbon and ammonia were there, they would react, and cause the gas to become dirty. The importance of this reaction upon the question of gas companies being fined for their gas being foul was considerable. He knew there were gas engineers who said they had no difficulty in getting their gas free from sulphuretted hydrogen; but there was the chemical fact that these two bodies did react, and that they were in the gas. He should like to know how they were to be prevented from reacting on one another, if the temperature and other conditions were suitable. The lime in the catch vessels was not wasted when it came out, but was utilized in the carbonate vessels, in which pure lime was not necessary. The oxide of iron which was used before the Weldon Mud was not revivified while in the vessels by the use of air, which enabled the mud to be employed more economically. Questions had arisen with regard to the effect of sulphuretted hydrogen on sulphur vessels, and as to whether or not it was necessary to interpose an oxide vessel between the lime and the sulphur vessels. They had worked the sulphur vessels at Beckton sometimes before and sometimes after the oxide ones, because the purifiers had in some sections been put in in such a way that it was impossible to change the oxide vessel without alternating, and putting the sulphur first before the oxide and then after. He did not say this method of working might never produce any injurious effect; but they were never able to say, if the sulphur increased, that this was the cause of it. The formation of the sulphide was a critical thing in the purification of gas from bisulphide of carbon. Mr. Carpenter's experiments were certainly very instructive; and when he told him about them some years ago, he was very much startled. It seemed to him that it did not follow, because it might be possible to form a sulphur vessel without the use of oxygen, that therefore one could not be formed with it. It seemed to him that, by the use of oxygen, some substance might be formed which answered the purpose; and that one might try to form a sulphide without the use of oxygen, and possibly succeed, though the chances were ten to one that he would not. It was certainly usual to fail completely in forming the sulphide without taking out the material, and exposing it to the action of the air. This was a common experience with people who followed the Beckton system as it used to be. The important bearing of this tender sulphide appeared to be this: When carbonic acid passed into a vessel containing sulphide and also sulphur compounds, the carbonic acid appeared to have a preference for the sulphide; but if this did not happen to be in a sensitive condition, it attacked the bisulphide of carbon compound. Otherwise the carbonic acid had a preference for displacing the sulphuretted hydrogen, and drove the entire thio-carbonate as it were into a corner, and only attacked it the very last.

The PRESIDENT remarked that the subject under consideration was so important, that a whole week could really be devoted to its discussion without exhausting it. To him individually the paper had been exceedingly interesting, as it had shown so clearly the necessity for bringing the mind of a chemist to bear on the practical *modus operandi* of gas making. Those who had been in the habit of purifying gas from sulphur compounds were aware of the great advantage derived from increasing the temperature. They also knew what a fearful result occurred occasionally when the purifiers were subjected to a low temperature. It seemed to him that they had hitherto been in the habit of attributing the successful results obtained in purification to the chemical action of the oxygen when introduced as an auxiliary, either in the form of pure oxygen or air. It now appeared that the factor from which they had derived the benefit was the mechanical increase of temperature; and that it was only necessary to prepare the lime in such a way as to retain the temperature obtained by the mere process of slaking, charging the purifiers with the hot material, and, by keeping up the temperature, to get exactly the desired effect without using either air or oxygen at all. In this direction the paper was to him of very considerable interest. The experiments, so far as they had gone, appeared to have been very successful; and it would be interesting to see if, when tried on a practical scale, the same effects were secured.

Mr. SALAMON, in reply, said their first duty was to thank the members for the manner in which they had received the paper, because they were fully conscious that they approached the question from the outside, and that their shortcomings in respect of a knowledge of the technical work of gas making were very considerable. It seemed to them, however, that, looking at the matter purely from the chemical side, there was some scope for questions of this nature being approached from the laboratory. The bulk of the remarks made by the speakers in the discussion seemed to be directed towards the question of the admission of oxygen in the sulphide vessel. He and Mr. Hood had been particularly anxious not to include in the paper a consideration of the action of oxygen upon lime sulphide, because they thought by so doing it would be perfectly impossible that the paper could be got through in any reasonable time. Since the matter had, however, been introduced by so many speakers, he would briefly give their views upon it. The question had not by any means escaped their attention; and it was a consideration of the changes resulting from the use of oxygen in the sulphide vessel that had practically brought them to the subject of their paper that day. If oxygen were passed into sulphide of lime, what was the result? Heat was developed to a small extent, forming a hot sulphide—a "tender sulphide," similar to the one of which they had spoken. But, concurrently with the formation of this tender sulphide (which was efficient in the removal of carbon bisulphide), what else resulted? There was the formation of hyposulphite of lime; and it seemed reasonable to conclude that the heat developed was due to the manifestation of chemical change in the production of that hyposulphite of lime. Now had the hyposulphite of lime formed anything whatever to do with the removal of the carbon bisulphide? If it had, then it would seem reasonable to produce as much hyposulphite of lime as possible. With that end they had made some experiments, and had saturated sawdust with hyposulphite of lime; and they found that it had no value whatever in removing carbon bisulphide. They, therefore, came to the conclusion that it was not desirable to form hyposulphite of lime. That could be proved in practice in this way: If too much air were passed in with the gas in the formation of the sulphide vessel, the sulphide was inactive, because there was too much hyposulphite of lime. Then there was another matter that had to be considered. Every time a molecule of hyposulphite of lime was formed, the sulphur contained in that hyposulphite was fixed, and could not be expelled by means of carbonic acid. Therefore the sulphur would in no case be recoverable. No matter in what order the vessels were worked, the hyposulphite there formed would be fixed, and

have to be thrown away as refuse; and if it were formed in a carbonate vessel (as it might be), then it would be prejudicial to any attempts to recaustify the material. They came to the conclusion—subject to its being simply based for the present on laboratory experiments—that the production of this hyposulphite was unnecessary, and that the only effect it had was to produce this tender sulphide, which was valuable in the absorption of carbon bisulphide. In directing attention to this matter, they would ask the members to try experiments themselves on the relative efficiency of a sulphide prepared with cold lime and one prepared with hot lime. It would also be found (as was mentioned in the paper) that this difference between sulphides formed at various temperatures was turned to practical account in chemical industries. This was a fact that could not be gainsaid; and such being the case, and knowing that heat favoured chemical change, they would ask whether, in forming a sulphide vessel under conditions of cold, they were not going in exactly the opposite direction to all the recognized rules which regulated chemical operations. That was a point to be emphasized in connection with the use of sulphide vessels. In contradistinction to Mr. Carpenter (for whose opinion, he need not say, they entertained the greatest respect), they did not think that oxygen was necessary in the production of these sulphide vessels; but that the result might be obtained in a much simpler way. Time alone would show whether the results which they had obtained on a small scale could be translated into larger ones; but they were rather encouraged to hope that such might be the case by the fact that, when Weldon Mud was originally brought to the notice of gas makers, the experiments were only in the laboratory stage. Yet by bringing them forward, they were enabled to induce certain prominent gas makers to give the matter a trial. It was in the hope that they might similarly interest gas makers to look into this question of the formation of sulphide, with a view to the possible production of pure carbonate of lime, and to relieve the foul lime nuisance, that they had brought their experiments before the present meeting. Weldon Mud was undoubtedly susceptible to carbonic acid; and its value for the removal of sulphuretted hydrogen would be destroyed if it were continuously exposed to carbonic acid. There was in the Weldon Mud, manganous oxide, which was easily attacked by carbonic acid; and therefore, in order to get full work out of the Weldon Mud, it was very desirable to keep back the carbonic acid. Possibly what appealed to a chemist's mind as a satisfactory keeping back of carbonic acid was not precisely on all-fours with the manner in which it was regarded by practical gas makers, because it had been their experience to find that, after gas had passed five or six lime vessels, one after the other, carbonic acid was coming through in traces at the end of the sixth. This showed clearly that there was no sharp chemical action taking place in the lime which the gas had already traversed; otherwise, these traces would not be apparent at the outlet of the last vessel. It appeared to them that Mr. Lacey's remarks respecting traces of sulphuretted hydrogen bore very much in the same direction; because in the check vessels at Beckton (as he would admit) carbonic acid had been discovered in the Weldon Mud taken out. Therefore, it had come right through the whole series. They also found it in nearly all other works. It did not apply to one works more than another. He mentioned this because it showed that the lime did not exert a sharp and energetic chemical action in the removal of carbonic acid; and the point arose whether there was not a possibility of inducing this sharp action, so that the effective removal of carbonic acid might really be practically possible. It was the substitution of arragonite for calcite which would bring about this result, because the desire for union between carbonic acid and lime in the case of arragonite was so much keener than in the case of calcite that they "snapped together," and effectually drove out the sulphuretted hydrogen from every part. With respect to the extent of the saturation with sulphur of Weldon Mud, they had found in practice that it might be saturated without taking it out of the vessel at all—simply by using air as indicated, to 50 or 60 per cent. of sulphur; and probably it could be saturated to a still greater extent. But this was what had already been carried out on the working scale. In comparign the question of the amount of labour necessary to deal with oxide of iron and with Weldon Mud, and the figures quoted, they were extremely obliged to Mr. May for having suggested whether or not oxygen was employed with the bog-iron ore. He regretted to say he could not answer the question.

Mr. Lacey: It was not used.

Mr. Salamon said there would be a corresponding reduction in the expense of oxide of iron to that extent, assuming the oxide of iron was sufficiently sharp in its action to have taken up the oxygen which had passed through. As to the probable cost of Weldon Mud, they had purposely kept, as far as possible, commercial considerations out of the paper, because they did not think this was the right time to discuss them. But he might briefly say that, as the result of Mr. Horton's working, he had found—paying the price he was charged for Weldon Mud, and comparing it strictly in all other respects with oxide of iron—that he effected a saving of a little over £60 per 100 million cubic feet of gas made, as the result of his year's working. This saving was quite irrespective of any brimstone value, and all the other advantages which would be gained by using Weldon Mud in conjunction with hot lime. Mr. Paterson had asked whether Weldon Mud was restricted to sulphur absorption. In the scheme now brought forward, they desired to restrict it to this, because they found that if they could, as they hoped to do, use a very much less quantity of lime and take out practically in one vessel all the carbon bisulphide, and produce lime fit for recaustifying and practically free from sulphur in the others, and drive the whole bulk of the sulphur forward into a material which would absorb it, and which could be used over and over again, then there would be no foul-smelling products, and all the sulphur would be recovered in a marketable form, and the lime would be fit for use again and again. He did not think, therefore, that the advantages which might attach to this material were minimized by the fact that it was only applied to sulphur absorption. If they could find a cheap base—such as lime—which, when properly handled, would drive all the sulphur forward, the bulk of which was now left in the lime, and a sulphur absorbing material, which, by sharpness of chemical action and behaviour, would absorb it all, then it was far better to use lime, provided it were properly employed. With respect to Mr. Belton's question, as to the character of the gas on which the experiments were made, he might say that it was very varied. The bulk of it contained about 50 grains of carbon bisulphide, and the quantity of sulphuretted hydrogen and carbonic acid that would accompany such gas in normal cases. Mr. Carpenter, by his method of working, was also able to give a gas containing about 50 grains of carbon bisulphide without any carbonic acid at all in it; and the use of this material had greatly facilitated their experiments.

Papers by Messrs. Winstanley, Braidwood, and Carpenter on Working Inclined and Horizontal Retorts.

Mr. G. E. Stevenson said he rather regretted that the last paper had been read before the discussion on inclined retorts had taken place, because, although stoking machinery was in some sense a cognate question, it was difficult, from the manner in which Mr. Carpenter had treated his subject, to discuss the two together. He had dealt rather with the mechanical than with the economical side of the question. He (Mr. Stevenson) would therefore divide his remarks into two parts, and take first the paper of Mr. Winstanley. Great credit was due to that gentleman for having the courage to entirely reconstruct his carbonizing system after so comparatively little experience of a favourable character had been gained with inclined retorts. At one gas-works belonging to the Manchester Corporation, there was an installation of inclined retorts constructed on the same system as that which had been described in the paper; and, from his own observation of their working, he was able to confirm two statements at least which Mr. Winstanley had made—first, as to the quantity of coal carbonized and the gas made per mouthpiece per diem; and, secondly, as to the cost of carbonizing. But there was one serious defect about these retorts—they did not last; and he should be glad if Mr. Winstanley would say whether he thought those he had erected would stand as long as ordinary horizontal retorts. He found that they sank, and soon assumed the form of a curve. Doing

this, they naturally cracked, and holes appeared; and in a short time it was necessary to replace some of them. He made an examination of several of the settings when they were opened, and found that the reason of their sinking was that they were not sufficiently well supported. The supports were what one would suppose to be perfectly adequate in the case of a horizontal setting. With the inclined retorts, however, it was evidently insufficient; and he came to the conclusion that they required very careful supporting. The pressure of the retorts on the walls was not a vertical, but a sideway push; and, unless they were very substantial and well built, they were apt to be thrust out of position. He had always looked favourably upon the inclined system, principally because he had believed, and he now knew, that by its use one could effect great economy in retort-house space for a given quantity of gas made. He did not see, however, that there was any saving in the cost of construction; and he thought that on this point Mr. Winstanley was mistaken, and that there was some error in the figures. Taking the cost of the elevating machinery at £1378, Mr. Winstanley showed an expenditure per retort of £9 11s. 5d.; but it should be £19 odd—bringing the total to £99, instead of £89. Again, taking the figure of £70 16s. per retort, which multiplied by 6 gave £425 as the cost of a setting, Mr. Winstanley said this was for a carbonizing power of 9 tons of coal per day, and worked out at £47 4s. 5d. per ton per diem. But there again he had made a mistake, because he had previously said that he carbonized 7 tons per day; and he (Mr. Stevenson) considered this was quite as much as such a setting could possibly deal with. At 7 tons a day for the whole, it amounted to £60 14s. 3d. per ton. Comparing this with a setting of eight horizontal retorts, in which they would expect in Manchester to carbonize 12 tons of coal a day, and taking the cost of the setting at about £700, if this were divided by 12 it would come out to £58 13s. 4d. per ton. Consequently, there was really nothing to be said as to the difference of cost; or, if anything, the inclined retorts cost somewhat more for the amount of work they would do. But there was no doubt in his mind that there was a considerable saving in the expense of carbonizing. The apparatus used for charging the retorts was of a simple character; it was not subject to the wear and tear to which drawing and charging machinery for horizontal retorts was liable. The work to be done was of a lighter kind; and they found that, with a small installation of five beds, only two or three of which had been worked at a time, the cost did not amount to more than 1s. 6d. per ton, including all the wages of the men employed in the retort-house—one of the men acting as foreman, whose wages might really have been spread over a considerably larger number of retorts. Taking the question of the space occupied, Mr. Winstanley's retort-house was 72 ft. 6 in. wide, with two benches of retorts 15 feet long; so that there was in all a 30-feet length of retorts, whereas in an ordinary house there would be a 20-feet length. The make of gas per foot run of retort was not, however, any more than by the horizontal method. One could not carbonize more coal per foot run of retort; but more work was done in the same ground-space, because the retorts stood at an angle. Mr. Winstanley had mentioned that some people complained that there was not so large a production of tar with inclined retorts. He (Mr. Stevenson) thought this was true, although the difference was not very great. At Manchester they had 11 gallons of tar per ton of coal; but with horizontal retorts they obtained 12 gallons or more. He did not think it was an objection that the production of tar should be diminished. If they did not have it in tar, they did in gas; and he always considered that the more material they could convert into saleable gas the better. There was one item in Mr. Braidwood's paper to which he might make reference before leaving the subject of inclined retorts—namely, the cost of working with that plant. He gave it as (all expenses paid in the retort-house) 36·88d. per ton for horizontal and 20·55d. per ton for inclined retorts; but he (Mr. Stevenson) thought the former figure was very excessive—certainly for retort-houses worked by machinery—and that the latter was about the right thing, or rather more than the working of inclined retorts should come to. Turning to Mr. Carpenter's paper, he thought a few of his statements bore the impression of being derived rather from hearsay than from personal acquaintance with the machines. This was no doubt inevitable; and it did not detract from the paper as a basis of discussion. He (Mr. Stevenson) came from the home of power stoking-machines; and, although his experience with them had not been of very long duration, he had been able to draw one or two important conclusions. The first conclusion he had come to about stoking machinery was that the principal saving effected in the cost of carbonization was not so much in the actual use of the machines as in the mechanical contrivances for bringing the coal to the chargers. The second thing he noted as an important advantage was the greater rapidity with which one was able to draw and charge the retorts, and therefore the saving of the time lost in doing so; and, as a necessary consequence, the additional quantity of coal carbonized per mouthpiece per day, corresponding to an increased production of gas. At the Rochdale Road works of the Manchester Corporation, the whole of the charging and discharging of the retorts was done by machinery. There were three distinct types of machinery in operation, and four retort-houses, all worked under different conditions. In the first, or oldest, there were the original hydraulic machines, as designed by Mr. Foulis and Mr. Woodward together, which were put down and permanently established for regular working. They were actuated by hydraulic power; but there was no arrangement for bringing the coal to them by power. It was conveyed in scoops drawn on trollies by ponies attended by men; and in that house they did not find any saving worth speaking about over the cost of hand labour. The next house was worked with the same class of machine, with a slight modification; but there was a very ingenious coal-conveying arrangement by which the coal was taken from the waggons and tipped into a large hopper at the end of the house, broken, and raised by elevators from the breaker into a continuous conveyer, which carried it to the charging-machine, at whatever point it might be. There was no manipulation whatever of the coal by hand; and the saving effected by this arrangement was from 5d. to 6d. per ton. The third house was worked by the first power machine that Mr. West ever put down, constructed with a charging-trolly on wheels, which he used at that time also in his hand machine. It went twice into the retort, and distributed the coal in a very even layer; but it had to be done in two operations. The fourth house was worked by new stoking-machines of the Woodward and Crossley type,* driven by gas-engines. In the two latter houses, the coal was conveyed from the stores to the machines by the usual side elevators, and dropped from overhead hoppers into the charging-machines; and in these houses there was very little difference in the cost of carbonizing. Some extra expense was incurred in dealing with the coal in the two last houses, because during the winter months a number of men had to be employed in shovelling it into the breakers, which did not occur in the first house he had mentioned. But this was counterbalanced by some reduction in the working of the machines themselves. He came to the conclusion that, after all, the principal thing was the conveyance of the coal to the machine. Then the saving of time in charging was very important. In January last some figures were published in the JOURNAL OF GAS LIGHTING having relation to one day's working at the Rochdale Road station, showing a very high yield of gas per mouthpiece. This had occurred occasionally on other days; and it was always very large. This point assumed importance as bearing on the question of stoking machinery when he said that, of the total number of retorts worked at that station, only 25 per cent. were heated by generator furnaces—the remainder being old-fashioned retort-settings; and 50 per cent. of the retorts were round ones, of the old style, 16 inches in diameter. Yet the production of gas per mouthpiece attained 8000 cubic feet a day. This could not be done with hand stoking. It was rendered possible because, by drawing and charging by machinery, they could deal with so large a quantity of coal in the day, as there was so little time lost between drawing one charge and putting in another. They were able to carbonize charges of 3 cwt. with only four hours' duration; and he did not think this was ever done satisfactorily by hand stoking. With regard to Mr. Carpenter's remark, that Mr. West had somewhat gone backwards in adopting the scoop instead of the charging-trolly, he could not agree

* These machines were described and illustrated in the JOURNAL for Feb. 28 last (p. 356).

with him. Although the trolly did lay the coal more evenly than the scoop, it had many defects. It wore out the retorts very rapidly; and it never deposited the coal in the centre of them. There was always an empty space left in the middle; and this naturally became filled with carbon, and blocked the way, and also burnt out more rapidly. With regard to the new machine which Messrs. Woodward and Crossley had invented, he quite concurred in Mr. Carpenter's opinion that it would be better to have one gas-engine for driving all the machines than to have separate engines on each machine. He was at first very doubtful as to whether or not these machines would act well, because of the delicacy of the gas-engines; but he must acknowledge that he was agreeably surprised in this respect. They had worked throughout the past winter very satisfactorily indeed, as far as the gas-engines were concerned; and they gave very little trouble. He understood Mr. Woodward had now brought out a new invention by which he intended to work the machine by a continuous drum and friction pulleys, which were to be driven by a gas-engine situated outside the retort-house. If this could be practically carried out, no doubt it would be an improvement. With regard to the Foulis-Arrol stoking-machines, he had seen them at work at Glasgow, and thought them extremely beautiful; but he was a little doubtful as to the charging-machines working so successfully dealing with soft coal as they did with the material in use there. The bucket-carrier to which Mr. Carpenter had referred as having been adopted at Salford was the one he (Mr. Stevenson) had just alluded to as being in the second retort-house at Rochdale Road. It was put in there first, and afterwards adopted at Salford. It was a very ingenious arrangement; and, where it was possible to deal with one class of material, it was the best he had seen. The only disadvantage was that, as the material had all to be tipped into one huge hopper, one could not deal separately with different classes of coal. Generally speaking, the question between inclined retorts and machinery was not one of cost of working, in which there was not much difference. The advantage in inclined retorts was that of saving space in the retort-house.

Mr. Chas. Hunt (Birmingham) said he understood Mr. Carpenter to refer to a proposal to use drawing-machines, even though the charging might still have to be done by hand. On this he might say that for the past ten years they had worked one retort-house entirely on that system. Mr. Carpenter appeared to think very little advantage was obtained in this way, because the coal had to be kept at the back of the machine, and trimmed forward for the stokers—being consequently twice handled. In raising this objection, he (Mr. Hunt) imagined that Mr. Carpenter had in view the possibility of discharging the coal where the stokers could immediately take hold of it. But this was not at all a usual state of things; the coal being generally deposited in a store at the side of the house, the width of which made second handling a necessity. He was of opinion, resulting from his own experience, that considerable advantage might be gained from the use of drawing-machines alone, the first cost of which was comparatively small. If he gathered rightly, Mr. Stevenson claimed as the principal advantage to be derived from charging-machines, the previous handling of the coal which these necessitated. He doubtless spoke from his own experience. The arrangement for delivering coal to the machines was unquestionably of primary importance; but he (Mr. Hunt) could not conceive that the operation of charging the retorts by machinery was a matter of minor economy, seeing that one man, or at most two men, would charge as many retorts with a machine in an hour as would constitute a turn's work if done by hand. The saving, therefore, from the use of the machine must be considerable. With reference to the durability of inclined retorts, he was at a loss to understand why these should not be so set as to last as long as horizontal ones. They had not yet had sufficient experience with them in Birmingham to say anything very positive on this point; but, so far as he could at present judge, there was no reason to anticipate a shorter life for them. It seemed to him to be a matter of proper setting and efficient heating, coupled with the use of suitable material. Of course, if the retorts were not well and evenly charged, they would speedily show signs of unfair wear. He felt bound to say he did not take quite so sanguine a view of the future of the inclined retort system as he might have done a year or two ago. One defect which was present in his experience was the necessity for securing a uniform quality of coal. When one had to deal with coals of variable size, the difficulty of charging became considerable. He had seen the system at work when the coal was of fairly uniform size from day to day and from week to week; and the results appeared to be everything that could be desired. In his own case, however, he had not had the advantage of uniformity in his coal supply; and the results had been to a great extent disappointing. With suitable coal, they had admirable charges, which were well burnt off; but the next day perhaps the coal would vary, and the effect would be just as unsatisfactory. He therefore continued to hold his judgment in suspense as regards the merits of the system; and he was looking forward with interest and some little anxiety, to the trial he hoped shortly to make with machinery applied to horizontal retorts, as against the inclined arrangement, with the object of comparing the relative advantages of the two systems.

Mr. W. King (Liverpool) said he should like to make a few remarks on the Foulis-Arrol machine, as he had had the advantage of seeing the latest installation. Of course, he spoke with all deference, seeing that Mr. Foulis himself was present; but it might be interesting to have a little independent testimony on the subject. With regard to the drawing-machine, the members doubtless remembered seeing the machine in operation when Mr. Hunt gave them the opportunity of inspecting his retort-house at Birmingham; but he also very recently saw it at work at the Tradeston station of the Glasgow Corporation. No observer could fail to notice what an extremely light and handy appliance it was. It was so light that the floor would not require strengthening to carry it; and, in addition, no complicated driving machinery whatever was needed. Any person could with one hand drive it up and down the retort-house at a speed sufficient to overtake the work the machine had to do. There were few moving parts in it; and there was nothing of consequence to get out of order. Like the charging-machine, it was worked by hydraulic pressure of about 300 lbs. per square inch. The whole thing seemed to be so simple, slight, and easy of application, that he looked forward to its being a favourite piece of apparatus in retort-houses, even where the charging-machine might not be in use. With regard to the latter, he spoke specially with reference to the remark of Mr. Carpenter as to the possibility of its not evenly distributing the coal in the retort. The machine carrying 5 tons of coal was so light that two men could with readiness move it up and down the retort-house; and there were always men about who could give a little extra speed to it if desired. In that way the evil was avoided of machinery required to drive the charger, as might be the case with those of heavier construction. He noticed particularly that in this instance the retorts were charged by six strokes or pushes; and the whole operation, from the beginning to the end, occupied from about 29 to 31 seconds. It might very well be put down as a charge in 30 seconds. In that case, the machine was worked by hydraulic pressure, which seemed very applicable to the work it had to do. He specially noticed the distribution of coal in the retort; and in this instance splint coal was being used—it was not charging cannel at the time. He was also struck, in every single instance, with the extreme evenness of the charge throughout the retort.

Mr. S. Glover (St. Helens) said he could speak from practical experience of the working of Mr. West's hand machinery for charging and drawing retorts. One difficulty he saw about the Foulis-Arrol machine was the backing up of the charge by several strokes. He should like to ask whether, when the retorts came to be opened, there was any portion of the charge not properly burnt off where the backing up had taken place. Mr. West's charger ran into the retort twice. This reminded him of the difficulty Mr. Carpenter had mentioned, about putting a charge into the retort in different portions, leaving a thin layer and a thick layer—a suggestion which rather surprised him coming from Mr. Carpenter, seeing that he thought he would have remembered that the part which was thin would get carbonized quickly, and leave the thicker part not so easily burnt off. He put on to the entering end of West's charging trolly a flap hinged very high up, and with its lower edge travelling within half an inch of the retort-floor; so that, when the hinged flap came to the tail of the previous charge, it tended to back

it up very much in the way that Mr. Foulis's machine did several times over. If this was done with very great force, there was a hard block or core when the retort came to be drawn; but it did enable them to get the charge properly into the retort. With West's machine, one could charge a retort, making two journeys to complete the charge, in 30 seconds, and get a very even layer. There was little difficulty in drawing the retort with West's hand machine. Their retort-house at St. Helens had no coke-vault for receiving the coke; it had to be wheeled away in barrows. The entire charge could be drawn in a very few strokes. The whole of the retort-house work was done at a cost of 2s. a ton, including emptying the coal from the waggons into the coal-breaking machine, attending to the fires, and removing the coke from the retort-house right away. The charges were thoroughly burnt off; and there was no difficulty at all. He should like an answer to the inquiry as to the repeated strokes the charge had by Mr. Foulis's system.

Mr. H. O'Connor (Beckton) said he would have liked to have heard if Mr. Foulis had any difficulty with this push-plate arrangement for forcing coal into the retort; and if it did not require a great increase of power when the retorts were old and uneven. An invention was brought out some years ago which had push-plates placed one behind the other, for forcing the coal into the retorts in one action. These left the coal in the same way as he understood Mr. Carpenter had no objection to—in slightly different levels, owing to the push-plate drawing up a little on the return journey. This did not work very successfully, owing to the great amount of power required to push the whole charge into the retort with one motion. With regard to the long conveyor which Mr. Carpenter mentioned as being in use at the Salford Corporation Gas-Works, he believed Mr. Foulis brought out an invention in 1883 for carrying a long scoop on wire ropes.

Mr. Foulis believed this was Mr. Warner's method.

Mr. O'Connor said that the invention he referred to was in conjunction with another invention for directing the coal into the charging-scoops at three different levels —patented by Mr. Foulis and Mr. Woodward. He should like to ask if Mr. Winstanley found any difficulty in the great thickness of coal. A 6-cwt. charge, with 15-feet retorts, gave a thickness of 6½ or 7 inches; and this seemed a great depth to get the whole of the gas out of.

The President said that, owing to want of time, he was compelled to say less than he should like to have done on the three papers under discussion, which were all of an exceedingly interesting nature. That of Mr. Winstanley explained the matter very fully; and as it gave so many details, it would be an extremely interesting one to study at leisure. That of Mr. Braidwood was also interesting; and he had undoubtedly met with considerable success in the direction he had taken. The third paper—that by Mr. Carpenter—was one with which he deeply sympathized throughout. He had a strong impression that the use of machinery for working horizontal retorts was likely to be very popular in the future. He might say that the hand machines were likely to be equally popular with steam, hydraulic, or any other power machines as aids to labour in doing very hard work. There was one thing which ought not to be overlooked in discussing the subject of the introduction of machinery for assisting manual labour. Where it was not employed, the stoker used to do the whole work; and he was paid wages which covered the cost of the wear and tear of the machinery then employed. When machinery was introduced, which, of course, could not go on without wear and tear, charges for lubrication, and so forth, these items constituted an important addition to the expense of manufacture. And although a saving in labour appeared in the revenue account, yet the item of wear and tear was increased. This was a matter which had not received so much consideration as it merited. It was likely to vary considerably with the different class of machines employed. With hand-power machines, the wear and tear was comparatively small; but with heavy steam-power machines, it would be greater. Probably with hydraulic power, as in the case of the new machines which Mr. Foulis was now developing, their reduced weight would cause the wear and tear to be somewhat less than that of the heavy steam-power machines; but this remained to be proved. He took it that, before many years had passed, they would find it expedient to introduce machines of some character for carbonizing coal, wherever it was possible.

Mr. Winstanley said that Mr. Stevenson had been good enough to make a few remarks with regard to the works in connection with the Manchester Corporation where an nstallation of the system as used at Coventry had been erected. The information which came to him stated that the sinking complained of was due to want of care and attention on the part of those working and looking after the settings; the whole had been allowed to get too hot, which tended to prove the efficiency of the regenerator furnaces. As to cost, Mr. Stevenson here made a mistake; the £1378 should be divided by 144 (the number of retorts to be erected) and not 72, which would give the cost per retort as stated—£9 11s. 5d. The machinery put down was sufficiently large for working the installation when complete. The total cost was therefore divided by 144, and not the figure 72 evidently taken by Mr. Stevenson. Again, with regard to the 9 tons of coal and the 7 tons, if Mr. Stevenson referred to the earlier portion of the paper, he would find the 7 tons mentioned had reference to the trial setting in which the retorts were 15 feet long, 22 inches by 15 inches section; the 9 tons being the weight carbonized per diem in each setting of the present installation, and in which the retorts were 15 feet long, and 26 inches by 15 inches section. At Coventry, there had been a slight sinking in the earlier settings, due to overheating; but the last half dozen settings were as good now as when first charged nine months ago. They were at present out of use, being prepared for next winter's work. With regard to the cost of the coal carbonized at Coventry, they frequently worked at 1s. 3d. per ton; the 1s. 6d. was given as an outside figure. As to the make per retort, it was a fact that a greater weight of coal could be put in per foot length of retort on this system than by hand, and possibly by machinery. In retorts on the horizontal, any thickness of coal could be placed in the retorts and worked off; but they would require a stronger heat to do this, and consequently necessitating more wear and tear. With inclined retorts, the charges were about 7 inches thick.

Mr. Braidwood said the costs of the settings in his paper were entirely based on working.

Mr. Carpenter said he might set Mr. Stevenson's mind at rest by saying that the statements made concerning the various types of machines had all been the result of close personal investigation, except in the case of the Crossley gas-engine arrangement. Mr. Stevenson had kindly supplied this one omission with reference to the Crossley-Woodward machine; and he also stated that he too had similar doubts to what he had experienced, but that they were not so well founded as he imagined. He was glad to have Mr. Stevenson's confirmation with regard to the great importance of the question of coal handling. It was rather overlooked how much the economy of machine stoking depended on this. When he said that Mr. West had gone back, he merely meant he had gone back from increasing the charge up to 4 cwt. per retort. He thought that this was wrong altogether. If Mr. Livesey were present, he would be able to confirm what he said as to the effect of these heavy charges on the make of gas per ton, compared with that attainable when the coal was burnt off in a fairly thin layer. With regard to Mr. Hunt's remarks, that gentleman was specially well situated (owing to the design of his retort-house) for using power for drawing in conjunction with hand charging. But the retort-house he saw last autumn at Birmingham was the only place he knew of where such a profitable application of drawing-machines alone could be made. He agreed thoroughly with what Mr. King said as to the advantage of the Foulis drawer. One could not watch the machine at work without being very favourably impressed with its delightful simplicity and ease of working. He, too, saw charges put in, and saw them drawn. They were a mixture of the splint coal they used at Glasgow; and the charges, he must say, were very well burnt off indeed. Doubts had arisen in his mind, not as to the suitability of the machine for cannel or splint coal, but for the very fine dust which was often invoiced to them in London under the name of coal, and which they had to carbonize. One remark of Mr. Glover's called for mention. He had not explained himself quite sufficiently. He held a strong view as to the wastefulness of thick and uneven charges. He thought coal might be placed in the retorts in ridges in such a way that a core would be formed in each, and the coal would be burnt off more quickly. He should like to refer also to the

greatly increased area required in setting horizontal retorts for a given make, compared with that for inclined retorts. He was altering a retort-house this summer, the superficial area of which was 10,948 feet, which would carbonize 204 tons a day. Mr. Winstanley's figures worked out to 9352 feet, which carbonized 200 tons a day; but, in addition to carbonizing 204 tons in the house in question, he should be able to store 700 tons of coal. Of course, this was not with an ordinary setting, but with one such as was first put up at the Imperial Gas-Works, London.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1011.)

THE past week has been a much quieter one on the Stock Exchange. Operations generally have been on a decidedly limited scale; and fresh business has been for the most part avoided. The prevailing feeling was largely one of doubt and anxiety as to the outcome of the next settlement; and fears were entertained that there will be a repetition, although not on so extensive a scale, of the troubles which made the preceding account a disagreeable experience. The tone has thus been dull; and prices generally are lower—the greatest fall being naturally in those markets which have of late disquieted the public mind so largely. The Money Market remains firm; and rates will keep up at least until the settlement is through, when, if all goes well, a disposition to greater ease may be looked for. Business in the Gas Market has been more extensive than it has been for some little time past, especially on Thursday and Friday. The tendency in prices was downwards—not from any esoteric weakness in the undertakings themselves, but more in sympathy with the advanced value of money, and the general shrinkage of quotations of all sorts. Gaslight "A" opened at 220, but later on gave way a couple of points—the closing mark being 218. Activity was resumed in the debenture and preference issues, all of which changed hands at well-sustained figures; but the quotations were left undisturbed. South Metropolitans were only moderately dealt in, and at the old prices; the "A" having about the best of it for choice. Nothing at all was done in Commercials, except one "special" deal in the old, at easy figures. The two or three transactions effected in the Suburban and Provincial Companies gave no sort of indication of any change in their position. Among the Continental undertakings, there was some reaction from the late rise in prices; and Union and Imperial retrograded slightly. Malta, however, advanced. Business in the rest was extremely restricted; and the only move was a recovery of 1 in Melbourne, owing to the improved financial outlook there. There was rather more activity in the Water Companies; but the tendency was adverse, and most of the chief issues dropped a few points.

The daily operations were: Business in Gas reopened very gradually on Tuesday after the Whitsuntide holidays; and nothing much was done all day. Melbourne debentures rose 1. More was done on Wednesday; but prices were not good, though quotations remained unchanged. Thursday was the busiest day, especially in Gaslight "A" and Imperial Continental; but the tendency was downward. Gaslight "A" and Continental Union dropped 2 each; but Malta rose ¼. Water was weak—Southwark falling 5; Lambeth, 3; Chelsea and West Middlesex, 2 each; East London, 1⅛; and Grand Junction, 1. Business on Friday was active; but prices were poor for most that was dealt in. Saturday was almost a blank; but Imperial Continental receded 2.

ELECTRIC LIGHTING MEMORANDA.

Differential Charges for Gas and Electricity—The Problem of Commercial Electric Lighting—The Cost of Gas and Electric Lighting—The Nuisance Caused by Transformers.

THE recent discussion upon the subject of differential prices for gas, at the meeting of the Institution of Gas Engineers, dealt with a matter that is even more interesting to electricians than it is to gas managers. The offer of discounts on the usual rate of charge, for the use of electric lamps in ways supposed to be specially advantageous to the suppliers of the current, is one of the most obvious devices for helping to make central station lighting pay; and the practice has accordingly been favoured in several towns. The latest instance in point is the Leeds undertaking of the Yorkshire House-to-House Electric Lighting Company. The Company began business with 7000 lamps fixed on the circuit, and an authorized charge of 8d. per unit. For not less than 250 hours' use per quarter of the maximum supply demanded, the Company offer to allow a discount of 10 per cent.; and there is a rising scale of discounts for longer use, attaining to the maximum of 25 per cent. for 700 hours per quarter. In addition to these discounts, 5 per cent. is to be allowed for cash in one month. These discounts bring down the net charge to large users—or rather, to long users—to 5½d. per unit. It will be observed that the advantage is given as we last put it, for using lamps the longest period of time, and not necessarily for the largest consumption. The purpose is clear—the Company seek to discourage mere "stand-by" connections, and to reduce the margin between the actual average and possible maximum load.

It is made more apparent than ever by such schemes of charging as the one just noticed, that electric lighting companies now realize the fact of their difficulty in making a profit being of an administrative, and not of a technical nature. It may be observed in passing, that the Leeds station, before being formally handed over by the contractors, was subjected to exhaustive trials, which completely established the high efficiency of the whole machinery. The consumption of coal slack was only after the rate of 2·45 lbs. per indicated horse power per hour (equal to 1·71 lbs. of Welsh steam coal); the water evaporated per indicated horse power was 21·11 lbs.; and the electrical efficiency of the dynamos was 93 per cent. It is pretty safe to say, therefore, that there is not much room for further economy in the matter of this description of station equipment. Yet, with it all, can the Company make a living by selling, at anything between 5½d. and 8d. per unit, electricity which, to take the engine-room expenses alone into consideration, can hardly cost more than 1½d. per unit to generate? The problem of commercial electric lighting lies between these figures.

Commenting upon the contents of one of those appeals to local authorities to embark upon central station electric lighting, with which many of these bodies are being so sorely beset just now, our contemporary the *Electrical Review* makes some sensible remarks upon the right way of putting the comparison of cost as between gas and electricity. The statement criticized put the question as being one of the cost of light to the householder, which is, of course, a very misleading way of treating it. This, as our contemporary truly says, is "*not* the comparison of gas and electricity, but a complex question in domestic economics." Certainly, a householder can so use electric lamps that his lighting bills shall be little more than they were for gas; but this is no satisfactory comparison. As well might one argue that the prices of beer and of champagne are equal, because the drink bill of an invalid ordered to take the latter beverage would not in some circumstances exceed the outlay of a navvy upon the former. Local authorities need to be very cautious how they deal with, or even entertain touting electricians, who only come to them because there is no trade doing in electric lighting companies.

A very serious case for the electric lighting interest has just been decided in the Queen's Bench Division. It was an action by Sir Coutts Lindsay, the father of the London Electric Supply Corporation, to recover rent alleged to be due in respect of a house next door to the Grosvenor Gallery. The defendant, the occupier of the house under a lease, pleaded an agreement entered into between himself and the plaintiff and the London Electric Supply Corporation, by which he was permitted to retain the rent for so long as his enjoyment of the house should be interfered with by the working of the engines and machinery of the Corporation. It was therefore a question of fact, to be decided by the jury, as to whether there was such interference. Evidence was given upon this head; and an electrician stated that the noise was due to the action of the transformers at the Grosvenor Gallery. The jury found for the defendant; and Mr. Justice Lawrance entered judgment accordingly, with costs. As the *Electrician* observes in this connection, for the comfort of those who may be interested in "the latest birth of time, the alternate current transformer sub-station system of distribution," if the ticking of a meter and the hum of transformers twenty feet below the street are to constitute an actionable nuisance, "the alternate current men are evidently not out of the wood yet." It seems a hard case; but nobody who has experience of the annoyance of machinery in a previously quiet neighbourhood, will hastily condemn a householder who makes a protest against any addition to the number of licensed peace-breakers.

Automatic Retort-Houses at Middlesbrough and Hartlepool.—The Gas Committee of the Middlesbrough Corporation, at a meeting held last Wednesday, accepted the tender of the New Conveyor Company, Limited, for the coal-breakers, and the coal and coke conveyors and elevators required for the extension of their system of inclined retorts. The arrangement—both working and setting—of the inclined retorts at Middlesbrough, is to form the subject-matter of a paper to be read at the Belfast meeting of The Gas Institute, by Mr. Terrace. The drawings prepared to illustrate the paper are of a very elaborate and complete description; and will show the *modus operandi* in great detail from the time the coal is shot from the trucks till the coke is reloaded—the whole work being entirely automatic. The coke elevators are to be of a new continuous tray-bucket type; and all the chains are made of Little's compressed-steel detachable links. On Thursday of last week, the Directors of the Hartlepool Gas and Water Company also accepted the tender of the New Conveyor Company for the coal-breakers, elevators, conveyors, and gearing for their new retort-house. The retort-house, having been arranged by Mr. Bower specially for inclined retorts, lends itself to a very complete and efficient system of automatic conveyors and elevators; and all the latest improvements—including Little's compressed-steel detachable chain, seamless steel buckets, and new form of casings, will be incorporated in this installation.

DR. ANDERSON ON SCIENCE AND ENGINEERING.

One of the fruits of prolonged experience that are being gathered by the present generation, is a knowledge of the proper use of memorial endowments. When it is desired to perpetuate the memory of a worthy man, it is not obvious how to do this in a manner that shall not be open to abuse; but, for a very wide range and a large category of celebrities, the best form of memorial that the wit of man has yet devised is the "endowed lecture" or "oration." In this way the name of a worthy who did good in his own day is identified with a perpetual source of enlightenment as well as of pleasure to his successors; and thus a great public service is done. For it is one of the most pressing needs of modern times that means should be found for procuring the occasional discharge, for the good of the community at large, of the accumulations of wisdom and learning which the best men of their age spend their lives in acquiring and developing. And for this end there is no such effectual means as the endowed lecture, which it is as much an honour to be called upon to give as it is improving to hear or to read. Happily, England is not at all badly off for endowments of this character; and they are constantly being added to. One of the last foundations of the kind is "The 'James Forrest' Lecture of the Institution of Civil Engineers," which has been established in honour of the renowned Secretary of the Institution. The first lecture under this trust was recently delivered by Dr. William Anderson—the subject being "The Interdependence of Abstract Science and Engineering;" and we regret that circumstances prevent us from publishing this masterly address in full, as several of our contemporaries have been able to do. It would be going undesirably wide of our regular way to follow this example; but we claim the pleasure of putting before our readers some gleanings from the lavishly poured-out store of Dr. Anderson's wisdom.

The orator had a grand opportunity; and he made good use of it. Starting with the foundations of engineering science, Dr. Anderson rivets our attention at once by declaring that "the days are past when an engineer could acquit himself respectably by the aid of mother wit alone, or of certain constructive instincts which have been almost the only guides of engineers and manufacturers, even down to quite recent times." But the speaker would be the last to deny that these innate qualities of the engineer can never be dispensed with, although it is increasingly necessary to reinforce native ability by well-directed study. But how and what the rising engineer is to study are not to be stated in a line or discussed in a paragraph. There is plenty of technical and scientific instruction to be had nowadays; and it must be made use of in a proper way. But, remarks Dr. Anderson, there is a new danger arising out of the popularization of scientific education and improved systematic manual training. It shows a tendency to impose itself as sufficient and complete education, "so that, though the operative approaches his work with increased intelligence, he remains unfit to reason out the great economic problems on which his own welfare and that of the nation depend." Dr. Anderson proceeds to remark how surprising it is to him that "so little attention is paid to the science of Political Economy, that not only the mass of people, in whose hands the voting power now lies, but even in a great measure the representatives whom they elect, have no systematic training in, and are grossly ignorant of, the principles which lie at the root of national prosperity." At the risk of being charged with presumption, we must interpose here the comment that, before Dr. Anderson directed the attention of engineers to the matter, we perceived the shortcoming of which he speaks in this passage, and varied the contents of the Journal with a good sprinkling of matter dealing with Political Economy.

Dr. Anderson has seen, with ourselves, the danger of allowing one's notions of this class of subjects to be coloured by the crude imaginings of popular demagogues. His observations on this head are very strong:

> "Politicians of the highest position do not scruple to trade on this ignorance, or to pursue a course which in its consequence is as bad. Being ignorant themselves, they strive to lead the ignorant, and set the operative against his employer and against society in general. The cheapness of newspapers, their wide diffusion, and their blind, not to say reckless, advocacy of popular fallacies acting on the ignorances, prejudices, and discomfort, if not suffering, of the operative classes, are giving enormous power to trade organizations, whose avowed object it is to improve the earnings and social standing of the operative at the expense of, or at any rate without regard to, the interests of every other class in the community. And this is to be accomplished, not by encouraging education, not by advocating thrift and temperance, not by urging the workman to improve his mechanical dexterity, the thoroughness of his work and the amount which he produces—but by holding out visions of shortened hours of labour, by compelling a minimum of pay which will enable him to live in comfort, of systematically restricting the amount of work done by each individual even in the shortened day, all under the fatal illusion that by such means a greater number of men will find more remunerative employment."

Nothing that we have advanced upon this subject is more uncompromisingly opposed to "new" and self-styled "progressive "industrial politics than this downright pronouncement. Again, the employer, says Dr. Anderson, is usually credited by the demagogues with invariably accumulating wealth, without effort, risk, or anxiety, merely as a return for taking the trouble to pay wages to a slavish band of operatives. The proofs to the contrary of this view, so easily to be found by whoever cares to look for them in the slender dividends declared by most industrial enterprises and in the bankruptcy returns, are steadily kept out of view. Dr. Anderson proceeds:

> "There would be no fault to find with the new class of professional agitators, who live by the discontent which they ferment, were they and the Unions which they manipulate, to contribute in the smallest degree to the obtaining of that work and of those orders in the execution of which the wage-earning portion of the community have their being. This, the most difficult part of every commercial enterprise, is left to the much-abused capitalist, so that the absurd and impossible system is fast asserting itself, that professional skill, mercantile ability, and capital shall obtain the work, and run all the risks of design, execution, and financial security; but that work shall be carried out according to rules which self-constituted and perfectly irresponsible bodies choose to impose. The smallest acquaintance with the principles of political economy would demonstrate that such methods must end in ruin."

This is the connection between engineering work in execution and the abstract science of Political Economy.

Trade Union domination, the lecturer next shows, is incompatible with the British principle of Free Trade. This system is characterized as perfectly reasonable and proper if thoroughly carried out; but it certainly does not contemplate the protection of one particular class—that of the wage-earners—and this, not by State edict, but at the bidding of self-appointed tribunals, whose claims amount to this: That there shall be free trade in all products which the operative requires to buy, but the strictest protection as to all that they have to sell—namely, their labour; and whose ultimate methods are violence and coercion. Following up this line of thought to the conclusion that the socialistic idea of equality in the condition of all members of the community is utterly impossible, Dr. Anderson adduces in support of his argument an altogether novel, but very professional illustration, in which Carnot's law of heat engines is given a politico-economical turn: "To obtain mechanical power from a source of heat, there must be a fall of temperature; and the greater that fall is, the more efficient will the engine be. A dead level of temperature simply means extinction of energy and of life. To ensure active trade and prosperous manufactures, there must be a fall of money or of its equivalent from the wealthy to the comparatively poor, the one class is absolutely essential to the other. The prosperity of the community is bound up in the existence of these differences; and a dead level of wealth would be a dead level of poverty, which would end, as a state of uniform temperature must end, in absolute stagnation and death."

Thus, however much we may regret the inequality that exists in the distribution of wealth and comfort, it is to Dr. Anderson just as much a law of Nature as the unequal distribution of warmth, of sunshine, or of rain, and seems to follow naturally and inevitably from the endless variations in the physical, moral, and mental powers of human beings, and to be like them unalterable at the bidding of man. Why, if labour, as the demagogues say, is all in all and the rest nothing, do not working men combine as in Trades Unions, and establish engineering works, and manufactories, or undertake engineering enterprises, and so appropriate for themselves all the golden harvest which the employer is supposed to gather? The reason is, simply, "Saturday night." Week's wages must be had, before which work must be found, bargained for, undertaken at great risk, and subject to all sorts of accidents, planned by able men whose number is small in any country; and capital and credit—neither in the possession of the workman—are equally necessary, with skill and industry, to the production of a good commercial result.

These are not questions of small or remote interest to the engineer, whose well-being depends upon the activity of trade and upon the existence of enterprise. "But the 'dividend-grabbers,' as investors in industrial enterprises are elegantly called by the foolish and ignorant men by whom the operatives are content to be led, will not embark their money in ventures where there is no prospect of reasonable interest, or where the hopes of such interest are endangered by labour agitations, encouraged, to a great and fatal extent by political parties, who do not scruple to purchase votes by holding out all kinds of Utopian prospects." Dr. Anderson sees no other remedies for this danger than the dissemination of sounder views on Political Economy concurrently with the spread of technical education, and the cultivation of abstract science.

Space fails for a full presentment of the remaining portions of Dr. Anderson's most suggestive address, which dealt with the character and achievements of James Watt, the development of iron bridges, the value of unremunerative research, the nature of heat engines, the qualities of the ether, Mendeleef's petroleum formation theory, molecular changes in iron, and a great number of other interesting subjects, not excluding animal magnetism. Every engineer should read the full text of the lecture right through from beginning to end; and he is likely to be a better engineer for the exercise. Throughout the composition the deservedly eminent author never once loses sight of the fact that he is an engineer and is speaking to engineers—men who in their work are still "careful to make theory and practice walk side by side, the one ever aiding and guiding the other, neither asserting undue supremacy." The whole lecture is full of similar good things.

Mr. R. W. Newman, of Hampton-on-Thames, was elected an associate member of the Institution of Civil Engineers at the last ballot of the present session, on the 16th inst.

THE MATHEMATICS OF WASHERS AND SCRUBBERS.

This is a subject that has not received systematic investigation at the hands of gas engineers. Various attempts have been made in the way of arriving at formulæ for calculating the area of condensing surface or that of the purifying boxes. But, with the exception of a rule in Mr. Newbigging's "Handbook," which gives the cubical contents of the scrubber as 9 cubic feet for every 1000 cubic feet of gas manufactured per diem, we are not aware of any similar formula for determining the area, extent of contact surface, or supply of liquid to the scrubber, or the dimensions of a washer, and the limit to which the subdivision of a current of gas may advantageously be carried. Makers of scrubbers and washers are usually prepared to supply an appliance guaranteed to deal with any specified quantity of gas; but this is more a matter of guesswork, founded upon practical experience, than of the application of any known or accepted rules. Under these circumstances, no apology is needed for directing attention to a paper entitled, "Coke Towers and Similar Apparatus" recently read before the Liverpool Section of the Society of Chemical Industry by Dr. Ferdinand Hurter, as elucidating points that have possibly never occurred to many of our readers.

In previous communications, the author has dealt with washers—that is to say, apparatus in which gas is divided into small bubbles, and caused to pass through a column of liquid. On the present occasion he takes two other classes of apparatus,—viz., that in which liquids divided into fine drops fall through the gas, and that containing solids with extensive surfaces and interstices covered with the liquid ;the gas passing through the interstices. It is not necessary to follow his investigations on the first of these two classes, since he shows most conclusively that it is inferior to the washer. "In all technical processes, the bulk of the gas is at least 100 times, and more often 1000 times, that of the liquid. When once this fact is clearly grasped it is easy to understand why the method of subdividing the liquid into drops is inferior to the method of subdividing the gas into bubbles." Dr. Hurter, however, does not rest satisfied with any assertions, but supplies mathematical reasoning and also experimental data, where practicable, in proof. Another interesting point against the spray producers is the fact that drops of water fall through the gas with much greater velocity than the gas rises or bubbles through the liquid. In the coke tower or scrubber, the fall of the liquid is retarded. This form of apparatus was proposed by Gay Lussac in 1827, and first erected by Mr. Gossage in 1836. The time occupied by any given particle of water in descending through a scrubber 40 feet high is put at 10 to 15 minutes; and, while not undertaking to estimate the surface area, the author shows that the coke occupies about 60 per cent. of the entire cubical capacity, and if the pieces of coke are taken as averaging the size of 4-inch globes or balls, the minimum contact surface cannot be less than 10·8 square feet per cubic foot of capacity. A scrubber 7 feet square in section and 40 feet high would therefore contain *at least* 21,168 square feet of surface. The time occupied by any given particle of gas in going through such an apparatus is shown to be proportional to the quantity passing per second. The area available for the passage of gas is equal to that of the full capacity of the scrubber, *minus* the space that is occupied by the coke, which is equal to 784 cubic feet. So a current of gas travelling at the rate of 20 feet per second would occupy $784 \div 20 = 39{\cdot}2$ seconds in traversing the apparatus. The contact surface area divided by the quantity of gas passed per second gives a simple and useful formula for arriving at the contact value of various appliances; but this is not directly proportionate to the chemical effect upon the gas. It is next shown that in the scrubber a given amount of contact value can be obtained with very much less power than that secured by subdividing the gas, and passing or forcing it through the liquid. Another great advantage of the coke scrubber is its reserve capacity. It contains such a quantity of liquid at any one moment that it will remain in effective operation for even an hour or more after the supply of liquid is stopped. A new scrubber of the size above named would retain 7500 lbs. of water; and one hour after shutting off the supply, about 5500 lbs. of this would remain. This renders the efficiency of the apparatus independent of small irregularities in the supply of liquid or in the quality of the gas. The question of alleged irregularity in the descent of the liquid, or in the ascent of the gas, by reason of the unusually wide space, is considered; and the conclusion is arrived at that, in practice, the movements are, to all intents and purposes, regular. Some experiments tried with a scrubber 4 feet square in section showed that the water from a single jet assumes a conical form, taken in vertical section, until about 8 feet depth of material has been traversed, after which it remains fairly equal. At 4 feet depth, it had spread over a circle 14 inches in diameter; and at 8 feet, over a 29-inch circle. The author's conclusion is that a well-constructed tower scrubber is one of the best contrivances for presenting a liquid to a gas. The paper concludes with a description of Lunge and Rohrman's plate tower—an arrangement recently introduced as an improvement on the coke tower.

It will, of course, be remembered that this paper does not touch upon some of the difficulties experienced in practice with coke towers on gas-works, such as the gradual clogging of the contact surface with tar or pitch, and the necessity for its periodical emptying and repacking. Few gas engineers would care to maintain that the cost of working the scrubber pumps and distributor is a mere fraction as compared with the extra work put upon the exhauster by increasing the pressure at the outlet to the extent of a few inches, which is all, or nearly all the extra cost of working a washer. The experiments with a jet of water show that a vast amount of unnecessary expense and labour has been incurred in the distribution of the liquid at the top of a scrubber, as a simple jet in each square foot of area would secure a practically uniform distribution of liquid within 4 feet of the top.

NOTES.

A New Opera-Glass Photometer.

Sir David Salomons recently read a paper before the Institution of Electrical Engineers upon a new form of portable photometer, this being a polarizing instrument depending on the comparative transmission of light through a pair of Nicol prisms, the respective positions of which are capable of alteration at will. The author states that if two Nicol prisms are mounted in a tube, and a source of light is observed through them, then the amount of light which will reach the eye is governed by a well-known law depending on the relative positions of the prisms to one another. It depends upon a junction of the angle which the polarizing plane of the polarizing prism makes with the polarizing plane of the analyzer. And since one-half of the light issuing from the observed light-source will never reach the observer's eye, being thrown out by the polarizer, the light which does reach the eye will be half of the original light multiplied by a function of the angle included between the polarizing planes of the two Nicols. In the instruments constructed to apply this principle to photometry, two tubes are mounted as a binocular, capable of being adjusted for distance apart; and it is used in the same way as a field-glass. One tube is then directed towards the source of light under examination, and the other to a standard of light; the distances being measured. Instead of moving either of the lights, equality is obtained by revolving the polarizer which faces the brighter source. The value of the light under examination in terms of the standard may be calculated when the amount of light cut off by the polarizer, the distances of the two light-sources, and the value of the standard are known. The standard employed with this instrument is a standard candle in a tube fed up to a constant level by a spring. The author claims that, with this instrument, powerful arc lamps may be compared with one another or with a standard light-source. It may be used for measuring various sources of light, such as daylight out of doors with light in a room; and it is described as exceedingly convenient, compact, portable, and easy to use. The instrument was sharply criticized, both on the score of its being an eye-piece instrument, and also on account of a candle being used as the standard.

The Incandescent Lamp as a Standard of Light.

In the course of the discussion on the paper of Sir David Salomons describing his new binocular photometer, Professor Ayrton stated that he has been experimenting for years with the object of getting a reliable standard of light in the form of an incandescent electric lamp run at very much below the normal brilliancy. He did not propose to state how far he had succeeded in approaching perfect constancy; but his experiment is aimed at discovering whether it is or is not possible to say that the light given out by a lamp when a perfectly definite current is sent through that lamp (which is never to be raised to anything like its normal brilliancy, so that, practically, there is no fear of blackening the glass) would for years be a perfectly definite thing. He has hopes that the result will be in the affirmative; but he admits that he is not quite clear about it yet, though it is years since the investigation was started in his laboratory. Supposing that the answer is "Yes," then all that will be necessary will be to take an incandescent lamp and send through the filament of this lamp a certain definite current, which it will be very easy to measure with perfect accuracy by means of a set-up ammeter—that is, an ammeter which reads between two limits, whatever these may be (say, the tenth of an ammeter and the fifteenth of an ammeter), and is really a current gauge, reading one current with extreme accuracy and no other current at all. In this way, Professor Ayrton declares that he has hopes of being able to supply a practical standard of light which will have none of the disadvantages of the standard candle—and, it may be remarked, will not possess the advantage of portability—and which will give exactly the same results from one year's end to another. But what of the colour of the light? Incandescent electric lamps worked much below their normal brilliancy resemble a freshly blown-out match more than anything else in Nature or Art.

The Nature of Town Smoke.

There was a discussion on town smoke at the last meeting of the Manchester Section of the Society of Chemical Industry, led off by Dr. Bailey, who gave a short account of the results obtained by the Air Analysis Committee, who are investigating the subject. Mr. G. E. Davis stated that he had lately repeated some experiments of earlier observers, having for their object

the determination of the nature of town smoke; and he had found that the hydrocarbons obtained from the smoke by aspirating it through absorbents belong to the paraffin series. Mr. Terry was able to support this statement; remarking that it is necessary to emphasize this fact because it is a favourite argument with sanitary reformers that there is a store of wealth in the form of benzenoid hydrocarbons escaping from house-fires. It is the same with the imaginary escape of ammonia, which would never pay to recover. Mr. Grimshaw warmly advocated the general use of gas-fires by those who can afford them; with coke for the poor. Dr. Bailey, in replying to the discussion, said that if the smoke was got rid of, the sulphurous acid would not trouble us. He pointed out that if gas only could be used for fire and light in the centre of a town, it would afford a great relief from fog. He suggested that a 10-candle gas might be supplied, carburetted by albo-carbon at the point of consumption for lighting purposes. He also stated that the burning of highly sulphurous gas in dwelling-houses is most injurious to health. Speaking of Manchester gas, Dr. Bailey went on to say that he had lately been experimenting to this end in a room; and he had found that, when three burners were alight, the sulphurous acid in the air at the top of the room was almost as much as in a bad town fog, and the contamination proceeded regularly to lower levels.

COMMUNICATED ARTICLE.

THE PEEBLES OIL-GAS PROCESS, FROM A SOUTHERN POINT OF VIEW.

By John T. Sheard, F.C.S.

The little gas-works at Peebles, where Messrs. Young and Bell's oil-gas process is being worked, continues to be a centre of attraction to the gas world; and is being visited almost daily by engineers and others interested in the subject from all parts of the country. The exhaustive report of Mr. F. T. C. Linton to the Edinburgh and Leith Gas Commissioners, the principal portions of which appeared in the JOURNAL for the 25th ult. (p. 738), and the adoption of the invention by the Galashiels Gas Company, whose installation is expected to be ready for starting very shortly, have served to awaken a wider interest in the process. It is beginning to be realized that, after a winter's successful work on a practical, if only on a comparatively small scale, there must be justification for the claims made on its behalf—claims which, being so much superior to anything realized by former methods of gas-making, seemed at first too extravagant to be implicitly accepted. Having recently inspected the process, my notes on the subject may be of interest to your readers.

The process is interesting from two extreme points of view: First, to the economist, as furnishing a cheaper illuminant than any hitherto known, and providing another means of utilizing with advantage the vast stores of petroleum and other oils throughout the world, for which there is not at present sufficiently adequate and profitable employment; secondly, to the scientist, as exhibiting in perfect operation the application to gas-making of the principles of fractional distillation and condensation—principles which have been long established, and the application of which in gas manufacture has been in part known and utilized, but which have not hitherto in their entirety been taken advantage of. Herein the new process furnishes another illustration of the gain to be derived from attacking industrial problems by reasonable methods, directly founded upon the results of scientific research.

There is nothing to add to the descriptions of the process which have already appeared in the reports published from time to time in the JOURNAL; but it may be of interest, and perhaps profitable, to discuss briefly, and chiefly from a southern point of view, the two aspects of the subject which have just been mentioned.

First, as to the scientific aspect. Paraffin and petroleum oils are mixtures of very many hydrocarbonaceous bodies, differing greatly in their composition and density. When such a mixture is distilled, those of its different constituents which distil without decomposition, boil and pass over at different temperatures—the boiling point rising continuously throughout the operation. Each separate ingredient does not boil and pass over simply at its own boiling point; but the quantity of each ingredient which distils, is the multiple of its tension at the boiling point of the mixture and its vapour density. For this reason, it is difficult to separate the members of the same series of hydrocarbons, because each member of the series in the ascending scale, though it has a lower tension, has a higher vapour density. It is here that, in the oil-gas process, the combination of fractional condensation with fractional distillation is of service. The cooling of the vapours taking place slowly and gradually, and the inclination of the conveying pipe being always from a high temperature to a lower, each different ingredient of the stream of vapours, as it reaches its own condensing temperature, is selectively separated therefrom. Thus, such vapours are returned to the retort as liquefy on being cooled to atmospheric temperature, or which are soluble in the raw oil with which the gaseous products of the distillation, after being cooled, are washed. Only those ingredients of the original stream of crude vapours are retained, which remain permanently gaseous at the lowest temperature to which they are submitted in the condensing plant, and which successfully withstand the solvent action of the oil. This double ordeal of cooling and washing with liquid hydrocarbon, which the oil gas has to go through, is sufficient warranty that the oil gas can be distributed, equally as well as coal gas, without losing illuminating power. I was informed by Mr. Bell that the temperature of the oil gas, as it left the oil scrubber, was, on many occasions during last winter, several degrees below freezing point.

The primary partial distillation, or first stage of the process, as above described, probably takes place within the ascension-pipe and mouthpiece. The condensed liquid, together with such of the original oil as has not been vaporized, penetrates further into the retort (which is set with a fall of about 1 in 9 from the mouthpiece), until it meets with the higher temperature requisite for its volatilization or decomposition, when the same process of eduction from the retort, with subsequent partial condensation, takes place.

When a complex hydrocarbonaceous compound is exposed in a retort to just sufficient heat to effect its decomposition, it is usually resolved into a lighter compound and a heavier—that is, there is formed from the decomposed body a simpler or lighter hydrocarbon (one in which the hydrogen bears to the carbon contained a higher relation than it did in the original compound); while there is left a compound containing more carbon compared to the hydrogen than formerly. One or both of these products may require to be still further decomposed, by cautious heating, before permanently gaseous products are obtained. The lighter, or more highly hydrogenized, body will, on further decomposition, probably yield more or less of free hydrogen, together with other hydrocarbons containing, some less, some more, hydrogen than that from which they are formed; a small quantity of carbon being also set free in the elementary state. The heavier, or not so highly hydrogenized, body will, on being submitted to a suitable temperature, be further broken up, with separation of lighter, and formation of still heavier hydrocarbon; and so the process may go on until the heavy hydrocarbon, having lost practically the whole of its hydrogen, has become condensed into a dense and complex molecule, almost wholly of carbon, forming coke. Such are the reactions and operations which in complex aggregation, go to produce the Peebles oil gas. In the process of distillation, the heat is carefully applied, at temperatures rising gradually to that required to perform the work of decomposing and rearranging, as required, the carbon and hydrogen of the original hydrocarbonaceous compound. If, however, instead of applying the heat at temperatures appropriate to do the work of decomposition in successive stages, it were applied at once in sufficient intensity to perform the whole decomposition at one operation, there would be an indiscriminate shattering and rearranging of the hydrogen and carbon, of which a large proportion would be set free in the elementary state, to the serious detriment of the hydrocarbon products of the distillation.

The Peebles oil-gas process would thus appear to consist essentially in evolving more fully hydrogenized bodies, which are gaseous at ordinary temperatures, from less fully hydrogenized ones, liquid at such temperatures. Viewed from this point, it will be seen how well adapted for this process are the paraffin and petroleum oils—consisting as they do chiefly of highly hydrogenized bodies of the C_nH_{2n+2} type.

Turning now to the economic aspect, it is a remarkable fact that the oil gas—which is of some 90-candle power, and so is available for enriching gas of low illuminating power to any required extent—costs, light for light, actually less to produce than common coal gas of 16-candle power. All previous experience in enriching coal gas, whether by cannel, carburetted water gas, or carburetting pure and simple, has shown a greater cost per candle, the higher the candle power required; that by this oil gas, the reverse is the case. This is such a remarkable statement, that it must be substantiated by the figures on which it is based.

Taking the analysis of the London Gas Companies' accounts, published in the JOURNAL of the 25th ult. (p. 726), the cost of coals, less residuals, for the year 1892 was 6s. 8d. per ton. This works out, on the yield of 16-candle gas obtained, to 2·45d. as the cost of an illuminating power equal to that of 1000 candles for one hour; or, in other words, the 16-candle gas supplied cost, for coals alone, 7·84d. per 1000 cubic feet. The yield of oil gas of 90-candle power is said to be 85 cubic feet per gallon, or 21,500 cubic feet per ton. As to price, a contract has been entered into at Galashiels for the supply of oil for three years at £2 12s. 6d. per ton, or 2¼d. per gallon. At this rate, without any allowance for the coke produced from the oil, which may be set against the charge for royalty, each 1000-candle power furnished by oil gas costs, for material only, 1·63d.; or the equivalent of 1000 cubic feet of 16-candle gas would cost for oil only 5·22d. In comparing the cost of the oil gas with that of coal gas in London, we should, however, take the cost of oil as it can be obtained there. Now it has been repeatedly asserted that petroleum oil (which is of about the same specific gravity as the shale oil used at Peebles, and of approximately similar composition) can be had delivered in bulk at 3½d. per gallon or for (say) £3 13s. 9d. per ton. At this price, the cost for oil to produce gas giving the illuminating power of 1000 candles for one hour would be 2·28d.; or the equivalent of 1000

cubic feet of 16-candle gas would cost 7·30d.—thus still showing a reduction upon the cost of the common coal gas. Yet this mode of comparison is unfair to the oil gas. The latter will only be used, it may be presumed, to enrich a low quality gas; and, as an enricher, it must be compared with other materials having the same application.

Hitherto cannel, carburetted water gas, and petroleum spirit (carburine) have been employed for this purpose. Of these, the last named is generally acknowledged to be the cheapest; and the lowest figure quoted as the cost of enriching coal gas to the extent of one sperm candle by carburine is 1·05d. per 1000 cubic feet. This amount, it must be added, is given by Mr. F. W. Clark, who is, I suppose, interested in the process; and it is much below that stated by Mr. F. Livesey, in a paper he read on the subject.* The cost for enrichment to the same extent by cannel is generally accepted as being not less than 2d. per 1000 cubic feet. On the other hand, the same service will be performed by the oil gas, at a cost for oil of only 0·46d., showing a very considerable saving. But this is not all. The almost completely automatic nature of the oil-gas process results in such a great saving in labour, that the gain under this head will, to the extent that oil gas displaces coal gas, probably be equivalent to quite 3d. per 1000 cubic feet of 16-candle gas; while the capital charges will probably be less than half the amount for oil gas than for coal gas, to produce an equivalent amount of light.†

There is another feature about the application of the Young oil-gas process to English gas-making conditions, which has not received attention, but which may have an important bearing upon its economic aspect. It is the probability of a higher illuminating value being obtained from the oil gas when mixed with common coal gas to give (say) a 17-candle flame. Having hitherto been used only under Scotch conditions, where it has assisted to furnish a 30-candle gas, this matter has not been investigated; but the general experience with illuminating coal gas goes to show that, *pro rata*, a higher luminous duty is obtained with a low percentage of unsaturated hydrocarbons than with a high. That is to say, each unit of illuminants in a flame develops a higher illuminating power the more it is diluted with non-luminous or with faintly luminous heating gases. Thus Dr. P. F. Frankland found, in his analysis of the gas supplies of twenty large towns, in 1882-4, that a gas containing unsaturated hydrocarbons equivalent to 4·42 per cent. of ethylene, gave an illuminating power equal to 3·62 candles per unit; whereas another gas, containing the equivalent of 10·64 per cent. of ethylene, gave an illuminating power equal to only 1·69 candles per unit.‡ It is therefore quite reasonable to conclude that, if the oil gas be employed to enrich to the extent of only one or two candles, not only will the admirable results experienced in the supply of 30-candle gas be maintained, but an ever greater economy will be secured.

Professor Smithells on the Structure of Flames.—At the recent *soirée* of the Royal Society, Professor A. Smithells performed some interesting experiments to demonstrate the structure of flames. He first effected the separation of a non-luminous coal-gas flame into two combustion cones; then, using benzene vapour instead of gas, he showed the transition from a simple luminous to a non-luminous flame. By introducing a spray of a solution of a copper salt, he demonstrated that the coloration of the flame occurs only in the outer cone, where oxide of copper is formed.

The Incorporated Association of Municipal and County Engineers.—There will be a Yorkshire District meeting of this Association next Saturday at Harrogate. After a reception by the Mayor, two papers will be read—one by the Borough Engineer (Mr. S. Stead), on "Municipal Work in Harrogate;" the other by the Water Engineer (Mr. Dixon), on the "Harrogate Water-Works." Visits will be paid to the Corporation sewage farm, to the water-works, and to various places of interest in the neighbourhood—among others, to the Royal pump-room, and the sulphur-water reservoirs.

Japan as a Coal Supplier.—During the past seven years, the output of coal in Japan has steadily risen from 310,000 tons to 1,040,000 tons. According to a financial contemporary, a statement, which is of considerable moment (if true) has been made, to the effect that a contract has been entered into with an American firm to supply 2,500,000 tons of Japanese coal to San Francisco, the deliveries to be spread over the next ten years. San Francisco is a large importer of coal—the imports having reached 1,250,413 tons in 1892, and hitherto the bulk of the supply has been obtained from Australia. It is to be feared, however, that Japan will prove a serious competitor for Australia, as it is said that Japanese coal can be laid down in America at a lower price than the Australian product. Moreover, since Japan produces on a silver basis, every decline in the exchange between gold and silver will act as a stimulus for increased exports from Japan.

* See JOURNAL, Vol. LVI., p. 1041.

† The estimate of capital charge is based upon the cost of the Galashiels plant, which is said to amount to £11 per 1000 cubic feet of 90-candle gas (maximum production) per day.

‡ See JOURNAL, Vol. XLIV., p. 17.

TECHNICAL RECORD.

MIDLAND ASSOCIATION OF GAS MANAGERS.

The Spring Meeting of this Association was held last Thursday at Worcester, and was exceptionally well attended. By the courtesy of the Directors of the Worcester Gas Company, the members met in the Board-room at the gas-works for the transaction of the little more than formal business on the agenda. Mr. B. W. Smith, of Smethwick (the President of the Association), was in the chair; and on the opening of the meeting Mr. E. L. Adlington, the Manager of the Worcester Gas-Works, on behalf of the Directors, offered the members a cordial welcome to the "faithful city of Worcester." Among the matters which came before the meeting was a communication from the South-West of England District Association of Gas Managers, forwarding the resolutions which that body had passed as to the desirability of forming a federation of the various District Associations, together with The Gas Institute and the Institution of Gas Engineers; and inviting the Association to send two representatives to a conference in London on the subject. A brief discussion took place upon it. Mr. Lewis (Wellingborough) moved a resolution that the Midland Association, without expressing any opinion as to the desirability or otherwise of a scheme of federation, would appoint two representatives to confer with the other Associations on the subject. Mr. Peaty (Burslem) seconded the motion, which was carried; and the President and the Hon. Secretary (Mr. C. Meiklejohn, of Rugby) were appointed for the purpose. After the business, the members inspected the different departments of the gas-works, and had an opportunity of seeing some of Drake's generator furnaces at work. Subsequently they were entertained by the Directors to luncheon at the city offices of the Company. Mr. John Stallard presided; and a short toast-list followed the luncheon. The rest of the day was pleasantly filled up by a visit to the Worcester Royal Porcelain Works, a trip on the River Severn in a steamer provided by the Directors of the Gas Company, and a "high tea" at its close at the Hopmarket Hotel

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS.

The members of the Southern District Association of Gas Managers held their Summer Meeting on Thursday last; and spent a long, fatiguing, but very profitable and enjoyable day, in getting through a mixed programme, that began with a gas-works inspection at Vauxhall and ended at the Mitre Hotel, Hampton Court. The President of the Association (Mr. C. C. Carpenter) had made special arrangements for showing the points of technical interest that have arisen in respect of the construction and management of the Vauxhall station of the South Metropolitan Gas Company; and consequently this part of the day's proceedings was much appreciated by the visitors. The Vauxhall works occupy a cramped and awkward site, the proximity of which to the residential area of South-West London renders careful administration imperative. Great pains have accordingly been taken to remove, or to minimize, all possible sources of nuisance or annoyance of every kind; and there is hardly another gas-works in the kingdom so inoffensively carried on. The problem of purification becomes a difficult one under such conditions; but Mr. Carpenter was able to demonstrate, to the complete satisfaction of his critical visitors, that it is possible to treat lime-boxes so as to render the spent material, in his own expressive phrase, "dead." The boxes are kept warm, if required; and the water in the lutes is covered with a protecting layer of oil. The same device is followed for all seals and traps that might give off an odour. Mr. Carpenter's retort-settings were well exhibited; some of the arches being lit up with gas inside, to show the flue arrangement. The coke removal and stacking of these works is effected by the aid of steam tramways most ingeniously disposed. The station is provided with very complete workshops, which were first established when it was the principal manufacturing station of the Phœnix Company. The gas made at Vauxhall is stored at Kennington Lane, whither the members were conducted, in order to inspect the enlarged gasholder, which has not yet, however, been raised above its guiding framework. Here luncheon was provided by the Directors of the South Metropolitan Gas Company, represented for the occasion, in the unavoidable absence of the Chairman, by Mr. R. Morton. The party subsequently went from Vauxhall Station to Hampton Court Palace, *viâ* Teddington and Bushey Park; and by permission of H.M. Chief Commissioner of Works, they were shown everything there is to be seen in and about the historic buildings and grounds. High tea at the Mitre Hotel concluded the day. The weather was all that could be desired; and the arrangements, in the capable hands of Mr. James W. Helps, the Hon. Secretary, were perfectly planned and most successfully carried out.

OHIO (U.S.A.) GASLIGHT ASSOCIATION.

The Annual Meeting at Columbus.

(*Continued from p.* 949.)

A paper entitled "Oils for Gas Making" was read by Mr. A. S. Miller, of Chicago. Commencing with a brief historical notice, attention was next directed to the Gale-Rand process for making high quality oil gas, and diluting it with air. This gas was liable to smoke, was easily extinguished by draught, and could not be economically diluted below a certain point. Gas enriched by passing in contact with naphtha at steam heat, was liable to smoke if raised to more than 20-candle power. Oil had also been utilized by mixture with coal; by the cartridge system, in which a quantity of small coke was packed into a tube, saturated with the oil, and the whole thrown into a red-hot retort; and by injection at a regulated rate into a red-hot retort. In every case, some diluent was found to be necessary, to prevent the smoky flame of the rich gas; and water gas was soon discovered to be most suitable for this purpose. The next step was the invention of apparatus for producing the two gases in proper proportion, over one fire, and at one operation. Pure oil gas was used on a small scale in many parts of the country, as the apparatus for producing it was simple and cheap. The oil could be gasified in retorts made of wrought-iron pipe over very simple furnaces; and if naphtha was used, no purifiers were needed. But this system could not compete with coal or water gas. At first naphtha was regarded as indispensable for water gas; but attempts were made in the way of using crude oil, or cheap residuums. A great deal of trouble was experienced, especially as regarded the fixing of the vapours. If this was not sufficiently done, the gas was not permanent; and if the fixing surface was hot enough, it soon became stopped with carbon, and naphthalene troubles appeared. These difficulties had been met, by increasing the extent of the fixing surface, and at the same time regulating the temperature. With their disappearance, there was a marked economy in the consumption of oil. Experience had also shown that it was better to fix the oil in the presence of the diluent, than fix it separately and mix afterwards. When the oil vapour was fixed alone, there was a tendency for the decomposition to proceed too far; and this was checked by the presence of the diluent. If ordinary illuminating gas was passed through a red-hot tube, there would be deposition of carbon, and loss of quality; but if first mixed with two or three parts of hydrogen or water gas, it would scarcely be affected. When oil was gasified alone, 750 candle-feet per gallon was rarely, if ever, attained; but with water gas, 1100 to 1200 candle-feet per gallon was obtained as a result of every-day practice. In deciding the kind of oil that could be used, it was necessary to consider the extent of fixing surface at disposal. Naphtha or light oil could be satisfactorily used, with an extent of surface that would be too little for crude oil or residuum. Crude Lima oil gave about 9 per cent. more light than naphtha prepared from it, both when distilled separately and when used for water gas. Besides this, the crude oil gave 7 per cent. or so of tar.

Discussion being invited, Mr. Shelton said that local conditions and prices affected the question of Oil *v.* Naphtha. In the past, crude oil had a distinct advantage; but things were rather inclined to change in this respect. Several plants were inadequate in regard to heating surface, in which case naphtha was undoubtedly the better. Mr. Starr used crude oil in a M'Kay-Critchlow apparatus, with satisfactory results. Mr. Butterworth remarked that he had lately been advised to use benzene for enriching. He did not know the difference between benzene and naphtha; but the price was not the same. Mr. Persons thought that benzine was too light and volatile to be of use as an enricher. Certainly, it was used in connection with some oil-gas processes; but that was at a very low temperature, and with trouble from tar and lampblack—in fact, benzene was largely used for the manufacture of lampblack. Mr. Gwynn said he had used crude oil by the Smith retort system; and he obtained 81 cubic feet of gas per gallon. He also tried benzene—specific gravity 72° Beaumé; and the yield was as low as 60 cubic feet per gallon. Mr. Milne stated that he obtained good results from the M'Kay-Critchlow apparatus with naphtha; but he considered the superheating surface too small for crude oil. Mr. Miller, replying to the discussion and to questions, said that crude oil called for more careful working than naphtha. The latter would stand a greater variation of heat without causing trouble. As a rule, the flashing point of naphtha was lower than that of crude oil, but not always. He could scarcely agree that Mr. Starr's results were entirely satisfactory, in view of the statement made by that gentleman a little time back about trouble from tar in the burners. Properly prepared water gas would not stop burners, any more than coal gas would. The superheating surface in Mr. Starr's apparatus was small. With 24 to 25 feet length of properly baffled surface, there would be no trouble with the burners. An apparatus designed for crude oil would give rather better results from naphtha than the old-fashioned sort; but he thought the M'Kay apparatus was best suited for naphtha.

At this point of the proceedings, the Committee on Tar presented a report, recommending the appointment of a Standing Committee for the ensuing year, with authority to ascertain the cost of a tar refinery, capable of producing pitch for electric lighting carbons; and also whether the gas companies throughout the State would co-operate, and subscribe capital *pro ratâ* for the establishment of such a refinery. The report was accepted; and a Committee of three was appointed.

Mr. Gwynn read a paper on the "Present and Future Competition between Gas and Electricity," which he had undertaken to prepare at the request of the Committee, and not at his own wish. Electricity, he said, was in their midst, and advancing with unparalleled rapidity in all directions—being pushed by unlimited capital and energy. There was no doubt but that it was a full-fledged competitor with gas, for while it had disadvantages on the one hand, it had advantages on the other; and it had an unlimited field to fill, and more opportunity for rapid strides and advancements than gas. In order to produce a paper based on actual facts and figures, and not merely his own views, he had communicated with some 200 gas and electric companies throughout the States; and he would direct attention to some of the statistics he had collected. In 1881, the sale of carbons for arc lights did not exceed one million per annum; and the price was £25 to £30 per thousand. Last year, however, the sale approached 150 millions; and the price was about £2 per thousand. The effect of this upon street lighting was shown by the fact that, out of 928 gas companies in the States, only 435 held contracts for the public lighting; the remainder having lost that department. In 1891 and 1892, the average increase of consumption experienced by 27 gas companies was about 6½ per cent. per annum. In the latter year, 14 electric companies doubled the number of incandescent lamps in use; the figures being 16,475 at the end of 1891, and 33,238 at the end of 1892. The same companies had, at the end of 1890, 1047 arc lamps; on Dec. 31, 1891, 1149; and a year later, 1620. It was supposed that but few electric companies could afford to operate day circuits; but this could be, and was done in towns of 20,000 population and upwards. A large demand was arising for ventilating-fan motors. In 1891, four of the principal electric companies sold 2012 of these; in 1892, 5093; and a still larger sale was looked for in the present year. There was also a great increase in the use of electric motors for various purposes, apart from tramways. In 1889, the sale of electric motors was not worth consideration; in 1890, five large companies sold 6600 horse power; in 1891, six companies sold 9650-horse power; and in 1892, seven companies sold 19,200-horse power. The sale of gas-engines in the same period would not exceed one-fourth of this. In supplying motors, the electric light companies were under the disadvantage that special circuits were required for anything over a very small size. This rate of increase could not be expected to continue, after the novelty had worn off; but improvement in electrical appliances of all kinds was going on. He mentioned these facts to show the need for energy and push on the part of gas companies, and the imperative necessity for low prices and good quality. The use of gas for heating and cooking should be developed, as there was an extensive field in this line that was not likely to be disturbed.

In the subsequent discussion, Mr. Nash pointed out that the increase in the use of gas was satisfactory; and with regard to the sale of electrical appliances, they must consider the way that business had been worked. Gas business had been conducted in an honourable kind of way; but he did not think the other had. With regard to the loss of the street lighting, this did not always result in decreased consumption. Many of them found it an unprofitable, and always a troublesome job, that they did not regret losing. The renewal of the lighting contract was always a costly matter; and many felt that they would not take it again if they had the chance. Mr. Douglas thought the comparisons made in the paper were not fair; one agent was merely in its early stage, and the other was not. Probably similar figures would obtain for gas during the first few years of its introduction. Mr. W. M'Donald remarked that the percentage method of calculating was most misleading. Suppose an electric company had one arc lamp supplied at the beginning of the year and two at the end, they would have increased at the rate of 100 per cent. To have anything like a definite comparison, they must take the actual amount of business done. Cent. for cent., he thought it would be found that the gas business had increased more than electricity. In New York, for example, the electric light companies gained 2000 to 3000 consumers during 1892; but those of the gas companies increased nearly 30,000. Mr. Faben agreed that the plan of taking the increase in the percentage of lamps, and comparing it with that of the quantity of gas sold, was misleading. The number of lamps, as compared with the gas-jets added, would give a more correct idea; but the volume of gas bore no proportion to the number of lights used. The amount of gas might be compared with the quantity of electricity supplied; or, the actual profit earned by the respective companies might be compared. In many instances, the electric lights were put in at less than cost, in order to secure the business. Mr. M'Donald said that, in a comparison of this sort, it should be remembered that gas was already fairly developed; while electricity was starting on a new field. If the time ever came when as large a proportion of the houses were wired for electricity as were at present piped for gas, it would be unreasonable to expect the 100 per cent. increase to obtain then. He had supervised the building of some 200 houses, all of which were piped for gas, while only five were wired for electricity. Mr. Miller agreed that there was a broad field for electricity; but in

many respects it could not be compared with gas. It was well known, for instance, to be altogether too costly for use as a heating agent. He did not believe there was a great deal of room for improvement in the present methods of producing and distributing electricity, nor much likelihood of the cost being so far reduced as to fall below that of good and cheap gas; but there was a very large margin for improvement in the lighting value yielded by coal gas. Mr. M'Ilhenny recounted some experiments made at a large hotel. Working their own plant, they could light the premises with incandescent lamps, at about the same cost as gas; but buying by meter from a local electric company, the cost was 2½ times as great. He also referred to independent evidence afforded by a widely-distributed investment circular, in which gas was referred to with confidence as a dividend earner; but it was stated that the expectations of electricians had not been realized. It was a fact that gas held its own—frequently in the face of utter inactivity, as compared with every possible push and energy on the part of the electric companies. Mr. Seamon was supplying electricity at Uniontown; but he found that meters were a necessity, if any dividend was to be earned. By their introduction, he had reduced the maximum amperage from 50 to 48; and the minimum, from 25 to 10. This showed it was unnecessary consumption during the daytime that ran away with the profits under the contract system. His plant was paying well, as he could get slack coal at 2s. 6d. per ton—probably the cheapest in the States. One consumer, who paid about 45s. per month by contract, had had to pay £10 by meter. Mr. Wilkiemeyer thought the facts given in the paper were an elegant compliment to the abilities of electrical apparatus sellers; but to get a fair comparison with gas, that business should also be run on the lines adopted to secure this large sale of lamps, motors, &c.

Mr. Gwynn replied, expressing the opinion that the advance in the use of electricity had never at any time been equalled by that of gas. His figures for electric lamps were based on the amounts actually received for lamps supplied on the contract system. He could not get any comparable information from returns of electricity supplied by meter. In the case of both gas and electricity, the increase he had noted was that indicated by the actual receipts over the counter. He knew the plants referred to in his paper; and most of them were run by gas companies, who would have no inducement to push the business after the manner that had been hinted at. Some of the gas companies mentioned had opposition electric light plants. The consumption per consumer appeared to get larger, from which it might be gathered that the increase in the sale of gas was not all due to new business. Many of the electric light companies had been in existence for eight or nine years; and the percentage of increase during the first year or two was much greater than that he had shown. The years 1891 or 1892 could, therefore, scarcely be regarded as commencing periods. He considered the comparisons to be perfectly fair. As an instance of a starting year, he knew a company that commenced working in 1890, and put in 1200 lights in the course of that year; while in 1892, they added 9500 lights. Most of the houses constructed at the present day were wired for electric lighting. He need not say that his object was to present a fair statement of facts, and not to advertise electricity; but it was idle to deny that, although gas might be advancing, many of the customers who were adopting electric lamps would have taken gas in its absence. He proceeded to quote figures showing that the increased demand for gas could be more than accounted for by the additional number of gas-stoves fixed; so that there was an actual loss as regarded the use of gas for illuminating purposes. Seven gas companies in Ohio were actually selling less gas than in 1891, notwithstanding reductions of price. As to New York, the electric business in that city had been checked by the enormous charges. Day circuits were not included in his figures at all, so that the introduction of motors did not affect them; and he agreed that no competition need be feared with regard to heating. It had been mentioned that many electrical companies were not making money; but they must not forget that many gas companies paid no dividend for the first ten or fifteen years. He did not think that no further advance could be, or was being made with electrical apparatus; and he instanced the new Westinghouse stopper lamp just brought out, which showed an improvement of 33 per cent. in efficiency as compared with ordinary lamps, and could be purchased at 1s. 2d. each.

The "Question Box" was opened, and found to contain several interesting inquiries. In reply to "Does it pay gas companies to rent gas-stoves?" Mr. Penn said it was better to sell them outright, if possible; but he did a good business by letting stoves of any size at a uniform charge of 1s. 0½d. per month. He regarded that as a good plan for introducing stoves; but, of course, it would not pay as a distinct business. Mr. Jones said that he let out stoves on similar terms; and he certainly considered it paid him to do so, as increasing the day consumption. Mr. Taylor objected that the hiring system involved a considerable amount of capital; and he preferred to fix stoves gratis on approval, to be either purchased or returned after three or six months' trial. Mr. Nash agreed, saying it was better to get back only the first cost of the stove. Mr. Dittmar liked to sell, as the charge for rent would not cover the repairs and renewals; but he undertook the repairing of stoves at actual cost. Mr. Roper said that, at Logan (Ohio), the plan of renting gas-stoves had proved unsatisfactory. Another question was: "What must be the relation between the cost of crude oil and that of coal or coke, before it will pay to use the former as fuel under boilers?" Mr. Miller said that the heating value of a pound of oil was one-third more than that of a pound of coal; and the oil weighed about 7 lbs. to the gallon. But it could be applied more economically, and without the large excess of air that was found to be necessary for the complete combustion of solid fuels; so that in practice 150 gallons of oil were equal to one ton of coal. The labour question also entered largely into the calculation—especially when working on a large scale. In an experiment made some years ago, he found that oil at ½d. a gallon was about even with slack coal at 5s. per ton. Mr. Nash had found four barrels of petroleum tar to be equal to a ton of coal. Mr. Penn understood that the Standard Oil Company were in the habit of selling oil at a price proportioned to the cost of coal. Mr. Gwynn had been told that oil at ⅜d. per gallon, used under a Babcock-Wilcox boiler, was a little cheaper than coal at 9s. 3d. per ton. Apart from the question of labour, Mr. M'Donald had found oil at ¾d. per gallon as cheap as coal at 6s. 8d. per ton; but as it was now quoted at over 1d., he had gone back to coal. The question of whether gas companies should retain the sale of stoves, or leave the same to dealers, was discussed; and it was agreed that the gas companies could do better with the stoves themselves, even if they sold them at a profit. In reference to another question, Mr. Gwynn stated that, with a Springer-Lowe double superheater apparatus, the consumption of materials per 1000 cubic feet of 20 to 22 candle gas produced, would be 45 lbs. of coke and 6 gallons of oil. A question having reference to the best form of street-main syphon to use, elicited the fact that two of the members have the cast-iron box away from the line of main and under the side walk, with a connection from the bottom of the main to the box.

Several other questions were discussed; and the meeting closed with the usual votes of thanks.

Mr. Francis H. Wood, late of the gas-works, Walton-on-Thames, has been appointed Manager of the Harlow and Sawbridgeworth Gaslight and Coke Company. There were forty applicants for the post.

Alleged Damage to the South Metropolitan Mammoth Holder.—At a meeting of the Greenwich District Board of Works on Wednesday last, Mr. G. R. Mason asked whether it was true that, in the construction of the Blackwall tunnel, such large quantities of sand and water had been drained from under one of the South Metropolitan Gas Company's holders in the marshes, that the holder—one of the largest in use—had been rendered unfit for the Company's purposes, and that in consequence an action had been commenced against the London County Council for damages. No reply was given to the question; but it is understood that communications in connection with the matter have been made to the County Council, and that damages are claimed for the disturbance of the foundations of the gasholder.

The Purchase of the Stourbridge Gas-Works by the Town Commissioners.—The decision of the Umpire, Mr. Shiress Will, Q.C., M.P., in the matter of the Stourbridge Gas-Works purchase, was made known at the end of last week. The price to be paid by the Commissioners is £99,800. The statutory dividends of the Gas Company amount to £3450; so that the above sum represents under twenty-nine years' purchase. The Commissioners before the arbitration had offered 25 years' purchase for the works, *plus* £1500, for winding-up expenses by the Company; but the Directors asked for an amount equal approximately to 35 years' purchase. The award does not include the £5500 debentures issued by the Company. The taxed costs of the award will have to be paid by the Commissioners. The undertaking will pass into their possession on June 30; and an agreement has been entered into with Mr. W. North, appointing him Manager, for five years, at a salary of £500 a year (the rental of house, and cost of gas and coal to be paid by himself).

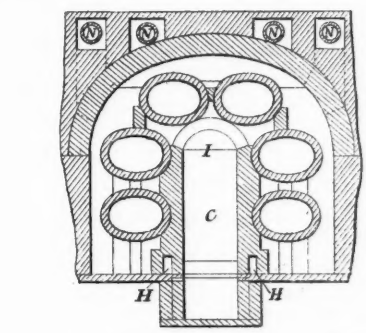
Death of Professor W. Foster.—We regret to record the death on the 23rd inst. after a short illness, in his 48th year, of Professor William Foster, M.A., F.C.S., Lecturer in Chemistry at the Middlesex Hospital, and well known to the gas engineering profession of the United Kingdom for the interest he took in photometry and the chemical side of gas manufacture and utilization. Professor Foster was for some time one of the Gas Examiners for London. He was a frequent contributor of papers to technical societies, and was a well-known figure at the meetings of The Gas Institute. He received a Telford Gold Medal and Premium from the Institution of Civil Engineers for a detailed account, published in 1884, of researches (originally communicated to the JOURNAL) extending over three years "On the Composition and Destructive Distillation of Coal." In collaboration with Mr. Dibdin, Gas Examiner to the London County Council, Professor Foster was appointed to investigate and report on the gas lighting apparatus of the Crystal Palace International Electric and Gas Exhibition of 1882-83. The cause of his death was acute inflammation of both lungs. The funeral was on Friday last; the medical school of the Middlesex Hospital being closed for the day as a tribute of respect to the deceased lecturer.

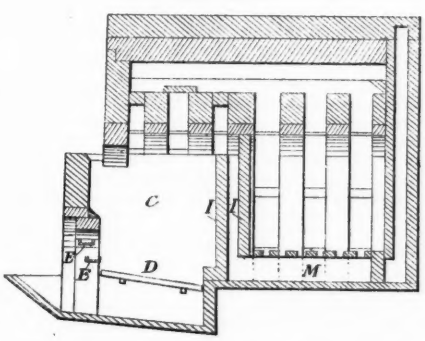
REGISTER OF PATENTS.

Heating Gas-Retorts.—Anderson, R. B., of Westminster. No. 11,102; June 13, 1892.

The object of this invention is "to enable gas-works where the retorts are worked from the ground floor, to employ a gas-producing furnace, as has been recently done in gas-works where the retorts are worked from a stage six to eight feet above the floor, and having a deep space below the retorts, into which the gas producing furnace has been placed."

The patentee proposes to place the producer inside the retort oven, much in the position where the ordinary furnaces have hitherto been; but the furnace is made deeper and the ash-pan sunk a little more below the level of the floor, than has usually been the practice. The chief passages for the admission of air commence near the floor-level, a little higher than the furnace-bars. The lower passages pass along the side cheeks of the producer, and deliver heated air to the producer gases, which pass off from the top of the producer and effect the combustion of these gases within the furnace. The primary air for the producer is admitted in the front between iron steps, and also underneath the furnace-bars, as usual. The furnace-bars, it is remarked, may be left out altogether, and the fuel so be supported on the solid hearth; the primary air supply then mostly passing through between the steps E at the front. Also the primary air supply can be controlled by a shutter in a door or doors covering the front of the ash-pit, as well as by partially closing the spaces between the iron steps by putting on to them some fine coke breeze, kept moistened by a trickle of water on to the top step.





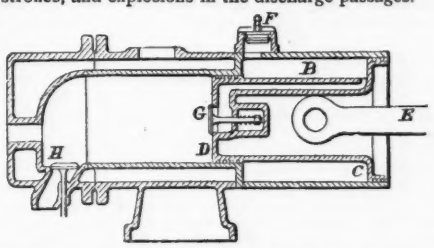
In the drawing annexed to his specification, the patentee shows various ways in which his invention may be carried out—that given herewith being the construction preferred.

The producer C is closed over at the top by blockings placed between the upper retorts and by carrying the back wall of the producer up to them. The blockings may, however, be omitted; and instead the back wall is carried up to the top of the oven, and the gases arising from the producer are led downwards through the hollow back wall I to a horizontal passage M, in the top of which they rise up into the combustion chamber to be consumed. The air-passages H deliver at their rear end into passages, which are on either side of the passage M; and the heated air is allowed to pass into the combustion chamber through openings formed in the top cover of these passages.

The gas and air passages may be covered with loose covering tiles, set nearer to, or further away from one another to control the combustion. When the circumstances of the case will not admit of doors being provided through which to actuate the loose cover tiles when the setting is at work, the tiles in constructing the setting are spaced so as to have an equal combustion throughout the setting, by having the openings smaller at the end next the producer than those at the remote end. If desired, a further admission of air to the interior may be made through pipes or channels placed in flues, through which the waste heat is conducted, as at N. In the arrangement shown, they would be led into outlet-flues in which are placed pipes N, which may be used for affording a further supply of hot air for combining with the gases arising from the producer. The front portions of the upper retorts are heated by radiation from the solid incandescent fuel in the producer; and should this be found insufficient, means may be provided by a damper tile for allowing some of the producer gases to pass off and be consumed among them.

Gas Motor Engines.—Anderson, F. H., of Openshaw, Manchester. No. 12,165; June 30, 1892.

This invention relates particularly to gas-engines working on the "Otto" cycle; its chief object being to increase the power of such engines and to adapt them for working as compound engines. Other objects are: To provide means for ensuring equality of effective charges in the cylinder, under various conditions of working; to render "Dowson" or other producer gas as effective as coal gas, or oil vapour or spray; to provide means of obtaining power from the gases after they have performed work in the combustion cylinder; and to prevent premature ignition in the cylinders, ignition during charging strokes, and explosions in the discharge passages.



Besides the ordinary working cylinder A, there is a cylinder B of larger diameter in the same line, having its piston C rigidly connected by a trunk to the smaller piston D, and linked to the crank-shaft by a connecting-rod E. As the connected pistons make their forward stroke, the smaller piston draws into the working cylinder, through the ordinary charging valves (not shown), a very rich explosive mixture of air with gas; and the larger piston draws air into the annular space surrounding the trunk through a valve F, controlled by a "timing" arrangement. On the return stroke, the smaller piston compresses the charge of explosive combustible mixture in the clearance or charge space of its cylinder A; and the larger piston, reaching the end of its cylinder B with little clearance, delivers through a valve G the air into the charge space of the smaller cylinder, which is thus charged with an extra quantity of more or less combustible mixture. This being ignited, the pistons are propelled forwards; and the larger piston C again draws in air. On the completion of this forward stroke, the exhaust-valve H is opened; and the pistons make their fourth or return stroke. The smaller piston D expels the products of combustion; and the larger piston C delivers air through the valve G into the working cylinder, so as to sweep out the residues of the products, and clear the cylinder ready for the reception of the next explosive charge. This completes the "four-stroke" cycle, which is repeated.

By suitably proportioning the mixture drawn into the smaller cylinder a combustible charge of great power may be obtained, because the large quantity of air delivered into the cylinder admits of a proportionally large quantity of gas.

The charge-space of the smaller cylinder A being always left full of air at the end of the fourth stroke, ensures that each successive combustible charge shall be the same, whether or not there has been an explosion during the previous cycle.

The excess air over that delivered into the clearance space during the exhaust stroke, passes by the valve H into the exhaust passages, and there acts as an incombustible wad or partition between the burning gases from the cylinder and such combustible gases as might be in those passages, owing to a defective ignition or other causes. Explosions in the exhaust-pipe are thus prevented.

Collecting Ammonia and Ammoniacal Salts from Gaseous and Liquid Mixtures.—Cuyper, E. de, of Mons, Belgium. No. 13,686; July 27, 1892.

This invention, says the patentee, has for its object "to collect from any liquid or gaseous mixture the quantity of ammonia or ammoniacal salts which it contains, and to transform the agent employed for the collection into a useful material for industrial purposes. By reason of the usefulness acquired by the material absorbing the ammonia and ammoniacal salts, the result obtained by its employment may in certain cases be double, inasmuch as the material acts, on the one hand, as a purifier, and becomes, on the other hand, a saleable commodity; while in other cases there is only one result, which consists in the greater value which the purifying material acquires by the absorption of ammonia and ammoniacal salts."

The inventor proceeds to point out that, "in order that the extraction of ammonia and ammoniacal salts, either from gaseous or from liquid mixtures, may be possible, it is necessary to treat the mixtures by the aid of an agent which will easily absorb the ammonia and the ammoniacal salts in great quantity. A material particularly adapted for this absorption is peat. If ammonia and ammoniacal salts are to be extracted from liquid mixtures or ammoniacal solutions, the solution is mixed with a quantity of peat necessary for absorbing the whole of the liquid after the manner of a sponge. If, on the contrary, gases are to be purified, the peat forming a filter is arranged in any suitable manner; and the gas is either forced or drawn through this filter."

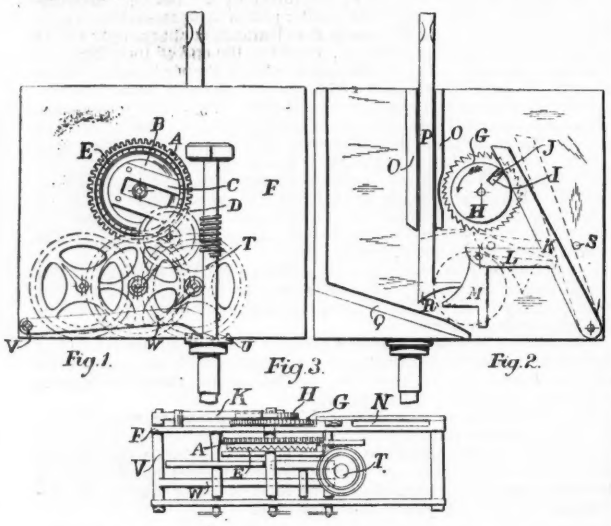
The employment of peat as a filter for ordinary lighting gas, it is claimed, constitutes a considerable improvement, "because up to the present time lighting gas has not been successfully freed from the ammonia and ammoniacal salts it contains, which salts prevent it from burning with the desired clearness and brilliancy, and give it a disagreeable odour as it burns. Moreover, this filter also retains any other injurious gases, such as free sulphuric acid, and the like."

Alluding to his invention, the patentee says: "Ammoniacal liquors produced in large quantities in the manufacture of gas can be deprived of their ammonia and ammoniacal salts by the process set forth for solutions. By the ammonia and ammoniacal salts which it absorbs, and by which it is gradually saturated, the peat is transformed into a manure of very superior quality, and constitutes an almost inodorous product. Moreover, peat is one of the most active elements for the nitration, so that when it has been left to itself for a suitable time, the greatest portion of ammonia will have been nitrated. The absorption, by the peat, of the ammoniacal liquors coming from gas-works, constitutes moreover a perfect means for recovering the pure ammonia contained in the residuary liquors. For this purpose, it is sufficient to heat the mixture of peat and ammoniacal liquors enclosed in a suitable receptacle (by the aid of a water-bath or other appropriate means) to

a temperature of from 30° to 40° C., so as to cause the disengagement of all the pure ammonia contained therein, whilst the peat retains all the salts which impart to it the quality of a superior manure. In the case of the treatment of residuary ammoniacal liquors, a simple result is obtained, when use is made of them directly, as peat transformed into manure; whilst a double result is obtained if the ammonia is first extracted therefrom by evaporation. The result is also double in the purification of gas, because, on the one hand, this element is obtained in an absolutely pure state, and, on the other hand, the peat acquires a value as a manure. . . . The process is moreover applicable to the direct obtention of pure ammonia contained in the products of distillation from ammoniacal liquors. When ammoniacal liquors are distilled directly (lime being added or not, for decomposing the salts), the products of this distillation contain an ammonia rendered impure as much by certain injurious salts and gases as by empyreumatic products, which commence to distil at about 80°. The ammoniacal liquor is caused to be absorbed by the peat; and in like manner this peat is caused to absorb the products of distillation of the ammoniacal liquid, for the peat, below a temperature of 80°, will retain the empyreumatic products, besides the salts and gases which render the ammonia dirty. By keeping the peat at a lower temperature than 80°, there will always be disengaged very pure ammonia."

Prepayment Gas-Meters.—Steele, J., and Brierley, J. W., of Oldham. No. 2219; Feb. 1, 1893.

This invention consists of locking and coin-freed mechanism applied to the ordinary counter or index of a gas-meter, as shown in the engraving.



A toothed spur-wheel A is employed, supplementary to the ordinary train of wheels of the counter, and mounted loosely upon a special spindle or arbor, gearing with the main driving pinion of the counter. Adjacent to this supplementary wheel, is a disc B, rigidly mounted upon the spindle; and, upon the face of this disc, a spring-blade C is affixed, formed with a tooth or indent D, which takes into a set of teeth E on the side of the supplementary wheel. The spindle or arbor extends outside the side-plate F, and is there provided with a ratchet-wheel G and a disc H, in the periphery of which latter is formed an opening or recess I. Into this opening, may take the projection J on the arm of the locking-lever K, which is pivoted to the side of the counter, and is so arranged as to cause the projection to bear against the periphery of the disc, and take into the opening I when it comes opposite thereto, and so prevent the disc turning round.

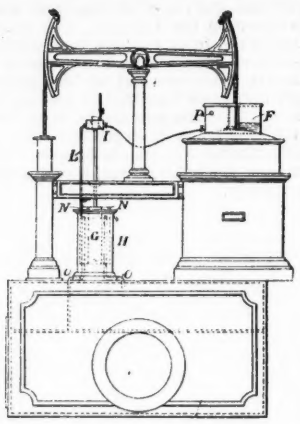
In order to unlock the counter and allow the gas to flow through the meter, the projection of the locking-lever must, of course, first be lifted out of the indented disc. To effect this, the locking-lever is formed with an arm L, to which is pivoted a peculiar shaped click-plate M, which will engage with the teeth of the ratchet G when acted upon as described. Upon the side of the counter is the vertical slot N, terminating under vertical guides O, in which a rod P can slide up and down. By inserting a coin (say, a penny) in the slot N, it falls down on to the incline Q, rolling against the rod P, which is in its lowest position. By then lifting the rod P to the position shown in dotted lines in fig. 2, the penny is allowed to fall down the incline against the arm L; and, upon pushing the rod down, the curved foot R causes the penny to press against the arm L, pushing the locking-lever over against the stop-pin S (as shown dotted in fig. 2), and causing the projection J to come out of the opening I in the disc H. The coin then bears against the click-plate M; and the last increment of movement of the rod P causes the coin to push past the plate, and simultaneously cause the plate to engage with the ratchet-wheel G, and impel it one tooth forward. The coin drops away into a box placed to receive it; and the locking-lever falls with its projection on to the periphery of the disc. Each tooth of the ratchet-wheel represents a fixed value of gas—say, one pennyworth—and the wheel G would be divided into a number of teeth corresponding with the price of gas—say, 40 teeth, if the gas was 3s. 4d. per 1000 cubic feet. The wheel G should have the same number of teeth as E. The disc H having been unlocked, and the ratchet-wheel advanced a fraction of a revolution, both are then free to revolve under the action of the counter and flow of gas, and through the frictional contact of the spring-blade C.

The setting back of the ratchet-wheel does not affect the counter mechanism, as it is permitted by the tooth or indent of the spring-blade C slipping over the teeth E. As the gas flows through the meter, the disc is rotated back again in the direction of the arrow; and thus in time—that is, as soon as the pennyworth of gas has passed—the projection J on the locking-lever falls into the indent I, and again locks the counter and stops the flow of gas.

In order to further lock the meter when no gas is passing through it, the worm-shaft T is provided with a ratchet crown-wheel U; and to the sleeve V, which forms part of the locking-lever K, is attached an arm W, the free extremity of which engages with the crown-wheel, as in fig. 1. This arm rises and disengages with the wheel simultaneously with the locking-lever, setting free the disc H.

Station Gas-Governors.—Hawkyard, J., of Saddleworth, and Braddock, J., of Oldham. No. 2961; Feb. 10, 1893.

The object of these improvements is "to produce a station gas-governor that will automatically give an increased outlet pressure whenever the demand for gas increases, and a diminished outlet pressure, as the demand for gas falls—such increase or decrease being constant, notwithstanding variations of inlet pressure."



The gas chamber of the governor is divided by a midfeather into an inlet and an outlet chamber; and in the midfeather are two valves, connected by rods and chains passing through water seals to the ends of a balance-beam, which oscillates on knife-edges supported on a pillar, as usual. There is a loading or pressure-changing tank F fixed upon the crown of the governor-bell, and containing water or other liquid. The supply and overflow of this tank is arranged to compensate for the effect of a varying inlet pressure (which would alter the position of the valves for the same quantity of gas passing through the governor), by the employment of two bells and a float G working in a liquid-tank, H. On the top of the float is an overflow-vessel I, connected to the loading-tank by a flexible pipe, so that the level of the liquid will be the same in both the overflow, vessel I and the loading or pressure-changing tank F. A constant supply of water may be given to the vessel I, which is provided with an overflow-pipe L or a nozzle, to carry off superfluous liquid; or a contrivance may be introduced to prevent the waste of water when not required.

When the governor is loaded to give the maximum outlet pressure desired at any time, and the valves are open to the full extent required therefor, the level of the liquid in the loading-tank will be at the highest relative point; and as the inlet pressure increases from any cause, the tendency of the governor-bell is to rise and partially close the balanced valves, and thus to throw off some of the liquid from the loading-tank into the overflow-vessel I, and reduce the outlet pressure. But the bells and float G, being subjected to the inlet pressure, and also to the outlet pressure, rise to the same extent, carrying up the overflow-vessel I, and thereby retaining the original level of the liquid in the loading-tank F, and maintaining the maximum outlet pressure. The float G rises and falls between two vertical guides in the tank H. This is provided with an overflow; and the float has attached to it two bells N. The pipes O are open above the water-level and communicate one to the inlet and the other to the outlet division of the gas chamber; or they may communicate direct with the inlet and outlet mains, so that both the inlet and outlet pressures are brought to bear upon the bells N.

The water may be supplied either direct to the vessel I, as shown, or to the loading or pressure-changing tank F; and the latter may be provided with an overflow at P, which is at the ordinary maximum pressure, so that the highest desirable maximum is attained when the water overflows, and even this can be exceeded, if required, by plugging the overflow aperture and allowing the loading or pressure-changing tank F to be filled to the top, giving the highest possible maximum pressure.

APPLICATIONS FOR LETTERS PATENT.

9674.—JOYNSON, F., "Obtaining carbonic acid gas from the waste products of combustion." May 15.

9690.—TAYLOR, J., "Saturators employed for manufacturing sulphate of ammonia and the like." May 15.

9771.—HAWKYARD, J., and BRADDOCK, J., "Apparatus for supplying gas or other fluid on prepayment." May 16.

9787.—BROOKES, A. G., "Gas-pressure regulators." A communication from Darius Wilson, United States. May 16.

9822.—CREWE, H. T., "Means and apparatus for starting gas-engines." May 16.

9958.—SCHLESINGER, R., "Incandescent gas-burners." May 18.

10,066.—SPICER, H., "Manufacture of gas for illuminating purposes." May 20.

10,075.—JONES, J., "Coin-freed check mechanism for use in connection with gas-meters." May 20.

10,111.—MARTIN, J. N., "Gas-chandeliers." May 20.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by our correspondents.]

Oil or Water Gas v. Coal Gas.

SIR,—I had the privilege of being present at the recent meeting of the Incorporated Institution of Gas Engineers, and hearing part of the proceedings; but, as I was not a member, and as what you are pleased to call "the courtesy of the floor" was not extended to me, I had no opportunity of taking part in the discussions, although some of the items interested me very much, and inspired me with a strong desire to do so. However, as the transactions have since become public property through the medium of the JOURNAL, I suppose I shall be strictly within my rights in placing before your readers the views and opinions suggested by them.

Let me at the outset call attention to one or two remarks contained in the Presidential Address: "The last two or three years have been serious times for the manufacturers of gas. Troubles have arisen in many directions—troubles with labour, troubles in obtaining supplies, and troubles in disposing of our products," meaning by the latter trouble, I presume, tar, for later on Mr. Methven remarks: "Tar products, I am glad to observe, are already advancing in value." Subsequently, he refers to the successful use of oil as an enricher of London gas, and remarks that it has "established for itself a permanently installed position." In the afternoon of the same day, two papers were read by two gentlemen, neither of them being a gas engineer, on the subject of "Carburetted Water Gas." One was by Professor Lewes, and the other by Mr. Glasgow, who has come here from America for the purpose of laying his services and experience at the disposal of English gas engineers, in order that he may teach them how to make gas—not from coal, of which we have an abundant supply, but from oil, which we have to import. Professor Lewes gives five important points to be considered in the manufacture of this gas; but cost is not one of them. However, we were able to gather, from the discussion, that the cost of this gas into the holder varies from 1s. 6d. to 2s. 6d. per 1000 cubic feet, which was said to be cheap, compared with the use of expensive cannel. But why use either cannel or oil, when the tar-wells are filled to overflowing with a hydrocarbon liquid of the richest and most infinitely varied character in the world, containing all the ingredients required in great profusion? When the President spoke of products, he practically meant tar, which, so far as I know, is the only thing that has been seriously depreciated in value, and yet attention is never drawn towards it as a likely friend in the hour of trouble.

Now, Sir, I am going to tell you a little story. Not a story of fiction, but of solid fact. I dare say, however, that to some of the gentlemen who so seriously discussed the above questions it will sound like an "Arabian Night's Tale." It relates to happenings in the town of Widnes, in the remote fastnesses of South Lancashire. This is not so far away as America; and, therefore, will not be appreciated so much. But it is much nearer; and it will, therefore, be much easier to put to the proof the statements I am about to make. I will begin, first, by saying that the Corporation of Liverpool Gas Examiner, who makes periodical tests of the Widnes gas, certifies it to be above 18 candles. At a recent meeting of the Widnes Corporation, it was decided, in view of the fact that they were making too much profit with the selling price of gas at 2s. per 1000 cubic feet, to reduce it to 1s. 10d. and 1s. 8d.; and, as they give the public lighting, this makes the average price of the gas distributed a fraction under 1s. 6½d. per 1000 feet. When I say that last year the fixed charges were 7·06d. per 1000 cubic feet, it will be seen that they have to make and distribute gas at a price not exceeding 11½d. per 1000 cubic feet. The material out of which this is done is slack coal, costing 7s. or 8s. per ton delivered; and, for a long period of time, they have had nothing else in the works. The only difference in the process of manufacture is that at Widnes they retain in the gas certain properties of the tar which at other places are permitted to flow into the tar-well; and it acts like a charm on the exchequer. These are facts that should not be overlooked by eminent gas engineers who are taking lessons in gas making from young Americans. Surely, what is possible in Widnes is not impossible in London. To me it seems a strange thing that, in this advanced age, we should be discussing the manufacture of "Carburetted Water Gas" at all, when the patent records of the past three-quarters of a century form the tomb of the dead and buried hopes of hundreds of men in the same direction. It would almost seem that everyone nowadays tries to develop an abnormal faculty for engineering at the expense of what I consider the more important factor of gas making.

Stalybridge, May 24, 1893. WM. CARR.

Electric Cooking and Heating.

SIR,—The controversy on this matter, which is at present going the round of the press, has developed into a form which is neither useful nor instructive, and has no bearing on the actual question involved.

Mr. Dowsing in *Lightning* for May 18 tries to compare the cost of electrical heating with that of coal—a comparison which is impossible, as the conditions required are totally different. He gives no exact figures to calculate from, as to the total available heat per ampère hour; and it is possible that the heating apparatus at present used may be greatly improved. The first apparatus designed can hardly be considered as final, although Messrs. Compton may be fairly credited with the first practically successful attempt to utilize electricity for domestic heating purposes. Taking Mr. Dowsing's own figures, with electricity at 5d. per unit, it requires about 3½ ampères for ten minutes to boil a quart of water; the cost being one-third of a penny. With the water at an initial temperature of 62° Fahr., this gives an expenditure of 375 units of heat in useful work—a cost rate of 1125 units for one penny. The only fuel which can compare with electricity is ordinary coal gas, which can be used under the same conditions, and with the same regard to economy in small and irregular work. One cubic foot of coal gas as supplied in London has a total heating power of 660 units; and of this more than 600 units are obtained in actual work in many commercial forms of bath-heaters. In boiling a small kettle over an atmospheric burner, the average duty in practice will not exceed about 400 units—*i.e.*, less than two-thirds the total theoretical work. Allowing a further margin, and reducing this to 375 units, a cubic foot of London gas will give at least the work of 3½ ampères for ten minutes; and 3 cubic feet, costing one-tenth of a penny, will do the work specified by Mr. Dowsing as costing one penny for the electricity used. No doubt each will have its own place, and will fill certain special requirements; but it is certainly a mistake to attempt to prove that electricity is, at present, a cheap source of heat.

No doubt the duty actually obtained from coal gas is very much higher than it was at first; and electricity has the very great advantage that its practical application is in the hands of trained experts, and has been so from the first. Possibly no industry in the world has so large a proportion of competent manufacturers and first-class workmen, who understand both the theory and practice of their work. The application of coal gas as a fuel, on the contrary, has been under a cloud for years, discouraged by the old proprietary companies, and hampered as it has been, and still is, by want of knowledge of the simplest natural laws, on the part of most of the men who have to make and fix the apparatus. It is only now beginning to emerge from a state of chaos. But, when it has been thoroughly established on a proper scientific basis, the manufacturers of coal gas will have no more to fear for its future than they have now from the beautiful old moderator lamps, which are so charming and so expensive, in our drawing-rooms and picture galleries. All are not fortunate enough, or rich enough, to have electric lighting, or to put in special ventilators for the removal of the products of combustion. When the purveyors of either gas, electricity, or moderator lamps assume the possession of perfection and infallibility, they only lay themselves open to attacks which are not always tempered with justice or discretion, and which cause a very unnecessary ill-feeling.

Warrington, May 24, 1893. THOS. FLETCHER, F.C.S.

Sales of Shares.—On the 18th inst., Messrs. Nichols, Smith, and Alder, of Bristol, sold by auction, in lots of £100, £25,000 of 5 per cent. stock in the *Bristol Gas Company*. The prices obtained were as follows: Five lots sold at £103 15s.; one, at £103 5s.; 21, at £103; 13, at £102 15s.; 16, at £102 10s.; 73, at £102 5s.; 21, at £102; 9, at £101 5s.; 37, at £101; 54, at £100 15s. The total sum realized was £25,454 10s.; the average being £101 16s. 6d.——At Chatham last Friday, Mr. W. Randall sold by auction five £5 shares in the *Brompton, Chatham, and Rochester Water Company*, at the rate of £15 each.——Last Friday a few shares in the *Gainsborough Gas Company* were sold locally at £39 12s. 6d. apiece, and £100 of original stock fetched £222.

Unlawfully Taking Water.—At the Greenwich Police Court last Wednesday, Robert Blackford, of Greenwich, was summoned at the instance of Mr. A. Dickson, the Secretary of the Kent Water-Works Company, for unlawfully taking water from their high-pressure mains. The defendant was in charge of a traction-engine, owned by Messrs. Mowlem, the contractors; and Mr. Wheatley, one of the Company's inspectors, deposed that he saw him open one of the hydrants at Lee, and, by means of a hose, fill the cistern of the engine. Mr. Dickson said the Company wished to assert the principle that no one could legally take water in such a way without an agreement, and that fire-hydrants were not allowed to be used except in case of an outbreak of fire. A fine of 40s. and costs was imposed.

Rochdale Corporation Gas-Works.—From the annual report of Mr. T. B. Ball, the Engineer of the Rochdale Corporation Gas-Works, we learn that the gas made during the year ending in March last was 385,623,000 cubic feet; being an increase of 4,600,000 feet. The gas sold amounted to 355,884,000 feet, or a gain on the preceding year of 3,600,000 feet. The increases reported for 1891-2 were 4,667,000 and 10,687,700 cubic feet respectively. Though the increase in the total quantity of gas accounted for this year is slight, it is certainly satisfactory, when the prolonged stoppage of the cotton-mills, and the general depression in trade, are taken into consideration. The profit declared by the department was somewhat less than usual—a fact which was attributable partly to continued depression in the market for residuals, and partly to extraordinary expenses incurred in regard to the laying of mains. Increased consumption of gas for purposes other than lighting had also affected the profit; it being the custom to supply gas for the purposes referred to at no more than cost price—viz, 2s. per 1000 cubic feet. Allusion was also made in the report to the proposed borrowing of £65,000 for gas-works purposes, and to the recent letting of tenders for the erection of a new holder and tank. The latter is being constructed by Mr. Daniel Eadie, of Stockport; and the accepted contractors for the holder are Messrs. S. Cutler and Sons.

Monte Video Gas Company, Limited.—Reporting to the shareholders on the working of the year 1892, the Directors of this Company state that the net profit amounted to £30,796, which has been passed to the credit of profit and loss. From this account, provision has been made for interest on debentures, for income-tax, loss on exchange, and bad and doubtful debts; and £1750 has been written off capital expenditure for depreciation. The balance remaining available for dividend is £35,566. Out of this the Directors have paid an interim dividend of 10s. per share; and they now recommend the payment of a further amount of 10s. per share—making together 5 per cent. for the year This will absorb the sum of £27,096, and leave a balance of £8470 to be carried forward. The stagnation in business and the general depression which characterized the year 1891 in Monte Video were continued throughout the past year, with the inevitable result of a further shrinkage in the revenue of the Company. But the Directors have the satisfaction of reporting that the economies which were possible both at home and in Monte Video, without interference with the full efficiency of the works, have resulted in the earning of a 5 per cent. dividend for the year, and the addition of £442 to the balance of undivided profits. This balance it is still thought prudent to keep in hand, to meet any contingencies which may arise. The current indebtedness of the authorities continues to be regularly discharged; but the Government old account to June, 1890, figuring in the balance-sheet at £5600, is still unliquidated.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS COMMITTEE.

(*Before Sir R.* TEMPLE, *Chairman; Mr.* LYELL, *Mr.* MYERS, *Mr. G. R.* BENSON, *and Mr.* BONHAM-CARTER, *Referee.*)

Friday, March 17.

PLYMOUTH, STONEHOUSE, AND DEVONPORT WATER BILLS.

On the re-assembling of the Committee this morning,

The CHAIRMAN suggested to Counsel for the Plymouth Corporation that the case for the Plymouth Bill might be shortened, as much of it had been developed in the opposition to the Stonehouse Bill.

Mr. BALFOUR BROWNE concurred. He then proceeded to call further evidence against the Bill under consideration.

Mr. *J. Mansergh*, M.Inst.C.E., stated that in November last he examined the site of the proposed reservoir of the Stonehouse Local Board at Cadover Bridge; and he did not remember seeing a worse one in his life. His impression formed by an inspection of the place had since been confirmed by an examination of the plans and section. Some of the disadvantages were mitigated by the modification introduced to raise the level of the water in the reservoir by 5 feet; but the unsuitability of the site remained. According to the modified plans, the dam at Cadover Bridge would be about 1100 feet, which was almost exactly the same length as the dam of the Vyrnwy reservoir which supplied Liverpool; but the storeage capacity of that reservoir was 13,000 million gallons, while the Cadover Bridge reservoir would hold only 54 million gallons. Even with the dam raised 5 feet above the level shown in the original plan, the reservoir would be very shallow indeed; and in the course of a very few years, it would be practically filled up. Flood water would bring down a lot of *débris;* and any little summer flood would stir this up, and spoil the water for days. Under these circumstances, filtration was absolutely necessary. In the alternative, a flood-water channel should be constructed round the reservoir, so that the flood, instead of passing through the reservoir and disturbing the water, should be delivered into the river at the dam. This would prevent the fouling of the water in the reservoir by the flood. Filtration would, however, be even better. Either filtration or a flood-water channel was absolutely necessary; but there was no provision for either in the scheme. A flood-water channel would cost something like £5200, which would be equivalent to an annual charge of £280. Filtration would come to less, as far as the actual works were concerned; but the expense of maintenance would bring the annual cost up to about the same figure. Criticizing Mr. Pritchard's estimate for carrying out the scheme, he said in his judgment the actual cost of the work would amount to £42,900. Filter-beds would entail, in addition, an outlay of £2000; and a service reservoir near Stonehouse, for which no provision had been made, but which was absolutely necessary, £2500. Legal and other expenses would bring the total outlay up to £48,700. This did not include the cost of a flood-water channel, and was exclusive also of the £400 a year to be paid to Sir Massey Lopes for water rights, which, capitalized, would be an addition to the estimate. If the scheme were carried out, the water would cost the Local Board slightly more than 4d. per 1000 gallons. In his judgment, Plymouth would be able, after its Head Weir scheme was carried out, to supply Stonehouse much more cheaply.

Cross examined by Mr. BIDDER, witness admitted that he spent only one hour on the site of the Cadover Bridge reservoir; but he had gained a good deal of knowledge from the plans. Asked in what way the Stonehouse scheme was inimical to Plymouth, he replied that it was not a *bonâ fide* application, but was brought forward merely to put pressure on Plymouth, in order to obtain better terms for water. Stonehouse was within its right in coming for parliamentary powers to obtain its own independent supply. It was inevitable that, sooner or later Stonehouse must be incorporated with Plymouth; and in that case Plymouth would be saddled with two water-works, when only one would be required. Practically he agreed with Mr. Pritchard in his estimates, except the cost of the dam, which he considered was under-estimated. If the Stonehouse scheme were carried out, the cost of the water would be reduced to 1d. per 1000 gallons when the capital had been repaid. If the Plymouth Bill passed, the Head Weir reservoir would be constructed in five years. The Plymouth Corporation did not construct the reservoir authorized by their Act of 1887, because they could not get a solid foundation for the dams; yet with that experience, they now came to Parliament for further powers to construct a dam lower down the valley, without having made a single trial hole.

Mr. BIDDER: Supposing that what happened with regard to the site of 1887 should turn out to be the case with the site of 1893, where shall we be in Stonehouse?

Witness: If you ask me to assume an impossibility, Stonehouse will, of course, be out in the cold.

In further cross-examination, witness said Plymouth, independent of its present scheme, could better supply Stonehouse than it had done in the past, because an enormous waste of water which formerly went on in the borough had been stopped.

Re-examined by Mr. BALFOUR BROWNE, witness stated that, when the Head Weir reservoir was constructed, Plymouth would possess an abundant supply of water for a population of 146,000. In his judgment, both Plymouth and Stonehouse should be supplied from the same source.

The CHAIRMAN: You were only one hour at Cadover Bridge. Is that sufficient time to enable you to pronounce a clear opinion upon the site?

Witness: I think so, with the information I have obtained from the plans, and from what I have heard. I saw the trial pits on the line of the proposed dam.

Questioned further by the CHAIRMAN, witness said he differed from Mr. Deacon's opinion that, having regard to the elevation and climatic conditions of the site at Cadover Bridge, there was no objection to the shallowness of the reservoir. He was unable to say whether the Stonehouse Local Board could have found a better site farther up the Cad Valley than the one selected at Cadover Bridge. For a reservoir of the character which the Local Board proposed, there ought to be a depth of at least 40 feet at the dam.

Mr. *G. H. Hill,* M.Inst.C.E., who accompanied Mr. Mansergh in his inspection of the Cadover site, concurred with him in condemning it as much too shallow. Speaking of the liability of the reservoir to silt up, he stated that the diminution in the storeage capacity of the Manchester reservoirs was reduced by 300 million gallons in 30 years by silt and *débris.* In his judgment, the storeage capacity of the Cadover reservoir would be destroyed by silting in 30 years.

By the COMMITTEE: His chief objection to the Stonehouse scheme was the unsuitability of the Cadover site. Dams, wherever practicable, should be thrown across a valley where it narrowed to a gorge. The Plymouth dam at the Head Weir would be constructed in a gorge; but there was no such gorge in the Cad Valley.

Mr. *W. B. Bryan,* M.Inst.C.E., the Engineer of the East London Water Company, corroborated the two previous witnesses as to the inefficiency of the Cadover site.

In cross-examination, witness admitted having spent only one hour at Cadover Bridge. Five minutes, however, were sufficient, he said, to convince him that the site was a bad one.

Mr. *R. N. Worth,* F.G.S., expressed the opinion that hardly a worse site for a dam could have been selected in the whole valley of the Cad, looking at it from a geological point of view; for floods came down with enormous rapidity, and brought immense quantities of silt.

This concluded the evidence against the Bill.

Mr. *G. F. Deacon,* recalled at the request of Mr. PEMBER, stated that he was quite satisfied that solid granite had been reached in the trial pits. But even if it had not been reached, the foundation of the proposed dam would be a perfectly water-tight rock, and would be much better than it was in the majority of cases. With the heaviest flood, the reservoir could not be filled in less than 15 or 16 hours, even if it received the water from the entire watershed; but a large portion of it was already diverted by the leat. Provision would be made to prevent silting by the construction of a small reservoir, in which the greater part of the silt brought down by the storm water would be deposited, and then discharged into the river.

Mr. POPE, replying on behalf of the Plymouth Corporation, said that the real question was upon what principle Parliament would deal with municipal expenditure in matters of this kind. If Stonehouse were a large community coming for an independent water supply, a neighbouring Corporation would not be entitled to say much against it. But Plymouth, Stonehouse, and Devonport were separate communities, created by legislation of the most antiquated character, which would never be sanctioned under the modern system of local government. He submitted that it was not an economical policy that so small a place as Stonehouse should incur independent expenditure in procuring a water supply, when, in the natural course of events, the two communities of Plymouth and Stonehouse must be amalgamated. He ventured to prophesy that, if the Stonehouse Bill passed, the Cadover reservoir would not be made, because one or other of the adjacent Corporations would furnish the township with the small quantity of water it required, and save the inhabitants the ridiculous expenditure which the scheme, if carried out, would entail.

Mr. PEMBER, replying on behalf of the promoters, ridiculed the idea that Parliament would ever sanction the absorption of Stonehouse by Plymouth against the wish of the inhabitants of the former town. But he submitted that the Committee had no right to prejudge the question of the amalgamation of the two towns at some future time. If the scheme adopted by Stonehouse was practicable from an engineering point of view, and would furnish an abundant supply of water, the Local Board were entitled to have it sanctioned by Parliament, irrespective of the possible change at some future time in the local government of Plymouth and Stonehouse. Criticizing the evidence of Mr. Mansergh, Mr. Hill, and Mr. Bryan against the Bill, he said no human being could possibly, in the short space of an hour, make so thorough an examination of the Cadover site as was necessary to allow of a sound judgment being formed upon it. He submitted that the case advanced by Plymouth against the Bill was not a *bonâ fide* criticism of the scheme, but an attempt to throw dust in the eyes of the Committee. For a moderate expenditure, Stonehouse could in two years obtain an independent supply of water, excellent in quality and ample in quantity; and they ought not, he contended, to be compelled to wait ten years until Plymouth carried out a scheme which the people of Stonehouse did not want.

Mr. LITTLER, on behalf of the Devenport Water Company, renewed the application made on the first day of the sitting, that judgment on the Stonehouse Water Bill should be reserved until the evidence upon the Plymouth and Devonport Bills had been taken.

The CHAIRMAN said the Committee would postpone their decision on the Stonehouse Bill until they had heard the Plymouth case, and then make a further communication to all parties concerned.

Weck Patent Centre-Valve.—We learn that this valve is now coming into use in England as a substitute for the old hydraulic valve, and the more modern form, the dry-faced centre-valve. Although it is more than ten years since the valve was first adopted on the Continent (where there are upwards of 200 of them in use, in most of the large cities), English gas managers have been slow to recognize its many points of advantage. We understand, however, that Messrs. C. and W. Walker have succeeded in introducing the valve into several large gas-works—among others at Sheffield, Bournemouth, Middlesbrough, Manchester, Huddersfield, Stafford, and Bromsgrove.

The Manchester Trades Council and Gas Contracts.—At the last meeting of the Manchester and Salford Trades Council, Mr. Keane drew attention to the action of the Gas Committee of the Manchester Corporation in regard to the fair contract clause. He complained that contracts were let out to firms who did not pay trade union rate of wages; and he said that, as fresh contracts were about to be issued, it was time the Trades Council gave some expression of opinion with regard to the matter. He moved that the Secretary should write to the Chairman of the Gas Committee calling attention to the subject, and requesting the Committee to take action with regard to it. The resolution was carried unanimously.

MISCELLANEOUS NEWS.

THE PRICE AND QUALITY OF THE GAS SUPPLY IN MANCHESTER.

The recently issued annual record of the proceedings of the Committee of the Manchester and Salford Sanitary Association contains a report by one of the affiliated societies—viz., the Noxious Vapours Abatement Association—in which the questions of the price and quality of the gas supplied in Manchester are dealt with.

In their previous report, the Committee gave reasons for believing that their efforts to obtain from the Corporation a reduction in the price of gas had been successful, and that the forthcoming estimates of the Gas Committee would be based upon the assumption of a reduction being authorized by the Council. They now say: "The anticipations of the Association were right so far as the will of the Gas Committee was concerned, inasmuch as that department of the Corporation, in response to the invitation of the Council to report on the desirability of lowering the price, recommended a reduction of 3d. per 1000 cubic feet. The Council, however, declined to accept the recommendation when made. After an interval of some months, the Committee determined to again approach the authorities, with an appeal for a reduction of price for gas used for motive power and heating purposes. A memorial to be presented was printed and circulated, with the result that upwards of 5000 signatures of gas consumers and ratepayers were obtained. It is hoped that the presentation of this memorial will have the result of obtaining a reduction of 6d. per 1000 cubic feet for gas used for purposes other than illumination, as that concession would place gas in successful competition with steam for motive power, where such competition is possible; and thus a very powerful factor would be employed in reducing the volume of smoke discharged into the air in the city and neighbourhood. In connection with this matter, the attention of the Association has been directed to the quality of Manchester gas; and a report has been prepared for the Association by Mr. Wm. Thomson, F.C.S. Arrangements have been made for the regular publication of such reports, with a view to ensuring the supply of gas equal, as regards purity and illuminating power, to that supplied at equal price in any other town. The importance of this will be appreciated when it is considered what damage is done to upholstery, decorations, books, &c., by gas overcharged with sulphur. To complete the apparatus necessary for making tests of the greatest possible precision, a special fund of £60 is required, towards which contributions are invited."

The memorial (referred to above), which was addressed to the Corporation Gas Committee, reads as follows: "Your memorialists have observed that, on the motion of Councillor Hutt, at the last meeting of the City Council, you were requested to consider and report upon the advisability of reducing the price of gas used for purposes other than illumination. Your memorialists recognize that a few months ago, in accordance with instructions from the Council, you recommended a general reduction of 3d. per 1000 cubic feet; and they regret that, on presentation of your report, a majority of the Council deemed it consistent and right to disapprove of your recommendation. Now that a distinction has been drawn between gas for illuminating on the one hand and for heating, cooking, and power on the other, your memorialists desire to emphasize the fact that gas will not successfully compete with coal at a cost greater than 2s. per 1000 cubic feet. It is not disputed that this charge would still leave a profit; and your memorialists trust that, in your forthcoming report, you will recommend a reduction of at least 6d. per 1000 cubic feet, for the following reasons: (1) Because it is desirable to encourage a greatly increased consumption of gas for purposes other than illumination, in view of the rapidly extending use of the electric light. (2) Because the increased use of gas instead of coal would effect a great improvement in the condition of the air of Manchester. (3) Because the present excessive price of gas is a hardship to small tradesmen who use gas during the day, in their work. (4) Because it is unjust to all large consumers of gas to compel them to contribute to the rates more than their proper share in proportion to the gas they consume. It is suggested that, as a test of the possibilities and usefulness of such a reduction, it might be tried for a period of (say) three years. For these reasons and others, your memorialists pray that you will strongly recommend a reduction of at least 6d. per 1000 cubic feet for purposes other than illumination."

The following is the report by Mr. Thomson to the Association on the quality of the gas: "I beg to lay before you as follows the results of the analyses of Manchester gas made by me on different days during last month, on behalf of your Association:—

Duration of each test.								Grains of Sulphur per 100 c. f. of gas Measured at 60° F. and 30 in. bar.
From	3.20 p.m.	4th Nov.	till	12.15 p.m.	5th Nov.	. .	44·17
,,	10.25 a.m.	8th ,,	,,	8.50 a.m.	9th ,,	. .	42·53
,,	10.30 ,,	9th ,,	,,	9.5 ,,	10th ,,	. .	44·11
,,	10.10 ,,	10th ,,	,,	8.56 ,,	11th ,,	. .	41·69
,,	9.53 ,,	11th ,,	,,	9.50 ,,	12th ,,	. .	40·29
,,	9.15 ,,	14th ,,	,,	8.55 ,,	15th ,,	. .	40·74
,,	9.39 ,,	15th ,,	,,	9.15 ,,	16th ,,	. .	41·00
,,	11.30 ,,	16th ,,	,,	9.30 ,,	17th ,,	. .	49·69
,,	3.0 p.m.	17th ,,	,,	2.0. p.m.	18th ,,	. .	45·73
,,	3.20 ,,	18th ,,	,,	10.25 ,,	19th ,,	. .	39·28
,,	12.30 ,,	19th ,,	,,	8.55 ,,	21st ,,	. .	46·64
,,	2.35 ,,	21st ,,	,,	1.39 ,,	22nd ,,	. .	43·12

To give some idea of the amount of sulphur burned along with Manchester gas, it might be advisable to put it into a popular form: Sulphur, as a fine powder, is sold under the name of 'Flowers of Sulphur.' If you take 43½ grains of sulphur in this form, and heap it up on a penny piece, it will cover the coin, and heap up to form a short column of half an inch high, whilst 10 grains would form a similar column on a shilling piece of about half that height. If 43½ grains of sulphur be burned within a few minutes in a room, the smell of burning sulphur would be sufficient to produce coughing. A good-sized burner will consume (say) 5 cubic feet of gas per hour. Four burners in a room burning at that rate would consume between six and eleven o'clock at night 100 cubic feet of gas; and, during that time, 43½ grains of sulphur (the average in Manchester gas during last month) would be burned into sulphur dioxide, which easily takes up more oxygen, and is converted into sulphuric acid (oil of vitriol). Thus the 43½ grains of sulphur would become ultimately converted into 132½ grains of oil of vitriol, or 72 grains measure, equal to 1½ teaspoonfuls, some of which would become deposited on the leather bindings of books, and on the decorations of the rooms in which such gas is burned. It would be very desirable to remove from the Manchester gas some of this sulphur. The cost of removal cannot be serious, as the Leeds gas, which is supplied at about two-thirds the price of Manchester gas, contains not more than one-third of the sulphur. In London the maximum amount allowed by Act of Parliament in winter is 22 grains, and in summer 17 grains; and the average amount actually contained in the gas is 12 grains per 100 cubic feet."

WEST BROMWICH CORPORATION GAS UNDERTAKING.

Annual Report.

The Secretary of the West Bromwich Corporation Gas Department (Mr. Thomas Hudson) has recently issued his annual report. It states that the borrowing powers have been increased with the sanction of the Local Government Board to the extent of £23,500 for extensions of works and plant; and that the borrowing powers conferred by the Consolidation of Loans Act, 1889, for the purpose of commuting interest on mortgage loans converted into stock, and for providing for discounts and costs of issue of stock allocated to the department to March 31, 1893, to the extent of £5150, have also been brought into account. The total borrowing powers in respect of the undertaking amount to £203,605, or, after deducting loans repaid out of sinking fund, which are not reborrowable, there was a net borrowing power on March 31, of £191,805. The loan capital at the end of March stood at £179,230, or an increase in the aggregate of £17,950, caused by an expenditure upon new plant, and by the apportionment of the discounts and costs of issue of Corporation stock allocated to the Committee to the end of the financial year. The capital expenditure during the year has been exceptionally high, through the extensions of the manufacturing plant now in operation; the amount expended under this head being £9674. The outlay upon the distributing plant has been £667. The total expenditure on capital account, amounting to £15,496, has been met by the allocation of Corporation stock; and there was left a balance of £868 unexpended standing to the credit of the account. The total capital expenditure is now equivalent to £9 os. 6d. per ton of coal carbonized, or £892 9s. per million cubic feet of gas made. The result of the year's working would, Mr. Hudson was afraid, be somewhat disappointing, as the surplus remaining after meeting the statutory payments, was exceedingly small. This has been brought about chiefly by the high price of coal, and the decreased value of coke, owing to the depressed state of trade in the district. The surplus has been further reduced by the larger payments required for the sinking fund and interest on the increased capital brought into the undertaking during the year, which, it was hoped, would have been met to a large extent by an increase in the sale of gas, instead of which there has been a decrease. The amount derived from gas shows a diminution of £340. This has taken place entirely in the last quarter of the year, and is attributed to the mild weather of February and March. The year just closed contained a day less than the previous one; and this has tended further to diminish the output. Of the 11,987 houses in the borough only 4965 are supplied with gas. The number of houses added during the year is 165; while the private consumers have increased by 126. The total number of consumers at the end of March was 5237—an increase of 139. The quantity of gas consumed by them was 185,322,400 cubic feet, or at the rate of 35,387 feet per consumer, which is below the average of the two previous years. There is an increase of 157 in the number of meters in use. The income from coke and breeze has been £7148, or a decrease of £1029, due partly to a reduced production, but chiefly to lower prices. The increased revenue from tar is £325; and from ammoniacal liquor, £288—the latter due entirely to the enhanced prices obtained. The total receipts from residual products are £10,001, against £10,403 in the previous year—a decrease of £402, which would have been greater but for the additional amount received from tar and ammoniacal liquor. The total income from all sources is £37,114, as compared with £37,800 for the previous year. The total expenditure for the year on the trading account has been £28,728 against £29,289. The total cost of manufacture was £21,288, or 1¾d. per ton of coal carbonized less than the previous year. The net cost of coal for gas-making purposes has been 12s. 9·85d. per ton, or 5¾d. per ton below 1891-2, which is the extent of the reduction in the price of coal. The total cost of coal delivered at the works is 12s. 11·88d. per ton, or a reduction of 5¾d. per ton, which brings the cost slightly below that of the year 1890-91. The cost of fuel for heating the retorts was £1758, against £1694, an increase of 1¼d. per ton of coal carbonized. The net cost of coal for carbonizing in 1893 was £3681, compared with £1496 for 1890. The cost of purifying was 1d. per ton of coal used below that of the previous year. The wages paid to workmen employed in carbonizing are practically the same in amount, although 1d. per ton of coal carbonized more than the previous year. The expenses of repairs, maintenance, and renewal of works are this year exceptionally heavy, owing to the renewal of a bench of retorts; and although £400 has been transferred from the depreciation fund account to meet this extraordinary outlay, the balance remaining as chargeable against the year is £159 in excess of the previous year, which is equivalent to 2¼d. per ton of coal used. The quantity of coal and cannel carbonized during the year has been 21,066 tons—a decrease of 595 tons, when compared with the previous year. The aggregate cost of distribution has been £1589 against £1395 in the preceding year—an increase of £193, of which the repairs and maintenance of mains and services are accountable for £170, and repairs and maintenance of meters for the balance. The former is due to an increased number of services having been laid during the

year, and to the breakage and fracture of mains caused by mining operations. The expenditure for salaries, &c., in the gas and fitting department was £1263, against £1269, although more business had been done. The balance of income over expenditure was £8386, or 4·68 per cent. on the capital employed, as compared with £8510 the previous year. The balance standing to the credit of the profit and loss account at the commencement of the year was £9939, out of which the Council devoted £1000 for the relief of the general district rate. The total amount standing to the credit of the account at the end of the financial year is £9070; and in connection with the sinking fund, there is a balance of £2284. The depreciation fund account had been reduced during the year by £400, which the Committee ordered to be transferred to the credit of the repairs and maintenance of works account. The amount standing to the credit of the fund at the end of the year was £3283.

STAFFORD CORPORATION GAS SUPPLY.

Annual Report and Accounts.

The report and accounts of the Gas Committee of the Stafford Corporation for the year ending March 25 last have been published. It appears therefrom that the sale of gas for the twelve months has fully equalled the most sanguine expectations of the Committee; the quantity made being 121,138,000 cubic feet—an increase of 8,995,000 feet, or more than 8 per cent.—and has realized the sum of £14,967, which is an increase of £522. As was the case last year, coal has been somewhat easier in price; but, in sympathy with that market, residuals have yielded less by £305, so that, notwithstanding the larger sales, the total income is, from this and other causes, £132 less than in 1891-2. On the other hand, expenditure has been largely increased by the higher rate of wages paid to the workmen and the adoption of eight-hour shifts in the retort-houses. These, with the loss sustained by the abolition of meter-rents, make the amount of profit considerably less than in recent years. Still, looking at the matter from the consumers' as well as the ratepayers' point of view, the Committee are of opinion that no fault can be reasonably found with the result. The net increase of wages amounts to £340; while the extinction of meter-rents, in addition to the extra discount allowed, reduced the income by £708, so that the Committee had to deal with an adverse sum of no less than £1048, as compared with the preceding year's balance-sheet. The total receipts have been £18,989; and the expenses, £12,430—the gross profit being £6559. Interest and sinking funds absorbed the large sum of £5138 (or £738 more than in the previous year); and income-tax, £180—there being thus a net profit of £1240 only, which, with £15 brought forward, left £1256 to be dealt with. At a recent meeting, £500 was voted, on the recommendation of the Committee, to the borough fund for baths account; and they now further propose that £750 be transferred to the district fund in aid of the district rate. Nothing has been added this year to the reserve fund which stands at £1564, and the depreciation fund at £1589. The amount of loans repaid is £18,625; and the total sum paid in relief of the rates by the Gas Department now amounts to £22,850. During the past year the new retort-house has been completed; and the results of its working with the new regenerative gas-furnaces (invented and patented by the Engineer, Mr. J. Ferguson Bell, Assoc.M.Inst.C.E.) are eminently satisfactory. A study of the accounts shows that, although so much more gas has been made this year than last, the cost of coal is less by £20, which is mainly due to the greater efficiency of these retorts, and the saving effected by the railway siding. New purifying plant is now at work; and during the summer months the whole of the purifiers (ten) will be fixed and prepared for use during the coming winter. In an analysis of the accounts, the following information is given: The coal carbonized during the year amounted to 13,245 tons. The quantity of gas made was 121,138,000 cubic feet, of which 110,157,300 feet was sold, and 1,211,000 feet used in the offices and on the works—leaving 9,749,700 feet unaccounted for. The average quantity produced per ton of coal carbonized was 9145 cubic feet, of which 8317 feet was sold.

THE DISPOSAL OF THE PROFITS OF THE HUDDERSFIELD CORPORATION GAS-WORKS.

The minutes submitted by the Gas Committee at the last meeting of the Huddersfield County Council stated that there was a balance of profit of £2821 on the working of the department during the three months ending March 31 last; and this they had resolved to transfer to the borough fund. The adoption of the minutes having been moved and seconded, Mr. Aston said he was aware the profit could not be dealt with at the present time, because it had already been absorbed in the estimate of the borough rate; but it was against the continuance of this system of transferring the profits of the gas-works to the borough fund that he wished to protest. In certain parts of the town, there were a number of shops and warehouses occupied only on Tuesdays and Fridays, and in some of which the amount of gas used did not equal the charge for the meter-rent. Many of these market shops were attended by people who were not ratepayers of the borough, but at the same time transferring of the profit on the gas went to the relief of their rates. Then there was a portion of Longwood which was actually not supplied by the Corporation with gas at all; and yet the profit went to the relief of the ratepayers in that particular district. On the other hand, there was the residential portion of the borough, the inhabitants of which consumed gas all the year round; and he looked upon the system of transferring the profit to the borough fund as a very great injustice to them. He should have brought forward the subject before if the profits had not been too small to mention; but now that they amounted to £2821 in three months (which was equivalent to something like £11,000 a year), it became a serious matter, and ought to receive the attention of the Council. He moved, as an amendment—"That, in the opinion of this Council, it is desirable that in future a certain sum out of the surplus profits of the gas undertaking, to be determined by the Council, be devoted to a depreciation fund; the balance, if any, to be applied in a reduction of the price of gas." He thought, if they took this course, those who consumed gas would get the benefit; and even as a commercial undertaking it would be advisable, for they would thereby induce people to continue using gas. Mr. Brook seconded the amendment. Alderman Taylor and Mr. M'Shaw asked the Council to give Longwood a supply of gas at the same price as was being paid in Huddersfield; and Mr. Brearley inquired whether, if there was a deficit on the gas undertaking, it would have to be made up out of the rates, and whether Longwood would not have to pay its share. Alderman Stocks, the Chairman of the Gas Committee, was at one with Mr. Aston as regarded the appropriation of the profits. He had always thought that the money ought to have gone to a depreciation fund, and that, if they could lower the price of gas, they should. Unfortunately at present the gas-works were undergoing transformation; and he was afraid it would be some time before they would be able to reduce the price of gas. Mr. Aston had multiplied the amount of the profit very nicely by four; but he should be very pleased indeed if the works paid their way during the next six months. He did not think the profit would be any more than in the past, which was barely above 1 per cent. upon the capital; and, in his opinion, no works ought to pay less than 4 or 5 per cent. During the past ten years, something like £70,000 or £80,000 arising from the profits on the gas-works had been handed over to the borough fund. He thought they ought not to go on handing over the profits to the relief of the rates, and impoverish the works until there was nothing in them, but that a certain proportion ought to go to a depreciation fund. Mr. Broadbent considered the method adopted by the Council of applying the profits to the reduction of the rates was decidedly to the advantage of the poorer ratepayers. Alderman Stocks, in reply to a question, said the depreciation fund stood at present at £10,000 or £11,000; but, during the past four or five years, nothing had been added to it. If they were to lower the price of gas a single penny, it would practically absorb the whole of the profits handed over during the last three months. The amendment was lost by 20 votes to 14.

WIGAN CORPORATION GAS SUPPLY.

The Working during the Year ending March 31 last.

The Gas Engineer of the Wigan Corporation (Mr. Jos. Timmins) has submitted to the Gas Committee his annual report, which, as usual, is of a very comprehensive character. The subject of extensions is first dealt with. During the year, new sulphate works, capable of distilling 40 tons of ammoniacal liquor per diem has been completed and brought into operation. An additional governor-house has been erected, and a commencement has been made in the erection of a new block of retorts, which, when finished, will contain ten through benches of sevens, representing 140 mouthpieces, capable of carbonizing 80 tons of coal and cannel, and producing 890,000 cubic feet of gas per day—thus raising the maximum producing power from 1,612,000 to 2,508,000 cubic feet per diem. The maximum daily consumption in the past winter has been 1,650,000 cubic feet. Drawings have been prepared, and contracts have been entered into, for two new purifiers, each 30 ft. by 20 ft. by 5 ft. 6 in.; also for the covering over of the old gasholder tank for the purpose of converting it into a tar and ammoniacal liquor well for storeage purposes. Considerable extensions have been made in the street-mains, for the better supply of the district generally and Pemberton in particular. Proceeding, the report states that, at the beginning of the year, there were on the register 6431 consumers, and at the end 7097; being an increase of 666. This is the largest annual increase that has taken place since the Corporation came into possession of the gas-works; and Mr. Timmins attributes this to the fact that the Committee have abolished meter-rents, and reduced the price of gas for lighting purposes 1d. per 1000 cubic feet within, and 3d. outside, the mile radius.

A comparative analysis of the working for 1891-2 and 1892-3 shows that in the past year 26,398 tons of coal were carbonized; being an increase of 899 tons. The quantity of gas made was 301,119,000 cubic feet, or an augmentation of 11,552,000 feet. The amount of gas sold was 282,968,000 cubic feet; being an advance of 11,329,300 feet. The increase as compared with 1891-2 (which was, however, abnormal) is not very satisfactory, which is explained by the fact that the mills, during a large portion of the season, were running short time; but, when compared with the three preceding years, it is satisfactory. The consumption of gas for working purposes amounted to 11,881,600 cubic feet; and for heating and motive power to 6,842,400 cubic feet. It is very gratifying to note that the increase for cooking purposes is 3,224,000 feet, or 37·24 per cent. With regard to the mixture of coal and cannel carbonized, it is mentioned that it cost 1·161d. per ton more than in 1891-2, which, on the 26,398 tons used, represents £127. As to the accounts, the gross profits for 1892-3 were £17,783; and the net profits, £5997—the figures for the previous year being £20,760 and £9140 respectively. The decline in the profits is owing to the seriously reduced value of tar, sulphate of ammonia, and coke, combined with the reduction in the price of gas, abolition of meter-rents, and fixing meters free of charge. The net profits for the past year are practically the same as those for 1888-9, which were £6202; but then the price received for tar was 23s. per ton, as against 11s. under the existing contracts. Much better prices were also being obtained for coke and sulphate of ammonia during the former year; and, moreover, the cost of coal and cannel carbonized in the past year was 2s. 10½d. per ton in excess of the price then paid—this one item alone representing £3639 on the quantity used.

At the last meeting of the County Borough Council, Mr. C. B. Holmes, the Chairman of the Gas Committee, presented the Engineer's statement and the abstract of accounts. He explained that the position was less satisfactory than it was twelve months ago, when he had to report that there was a net profit of £9000, and that the substantial sum of £6000 had been handed over for the relief of the district rate. Part of the falling off was due to the reduction in the price of gas during

the past year. They had hoped to meet the loss of revenue from this cause by obtaining from 6d. to 9d. per ton cheaper than in the previous year. But the estimate was overrated. A reduction of 3d. per ton was all they could get; and this resulted in a gain on the former year's purchase of £275. Then the loss by the reduction in the sale of coke amounted to about £600; while tar, for which in the year ending March 31, 1892, they had received 31s. 6d. per ton, had been this year reduced to 11s. per ton. They had also suffered by the reduction in the price of sulphate a loss of about £1265. By the short-time movement in the cotton mills, the expected increase in the consumption had fallen to 4·11 per cent. The leakage, which stood in 1883 at 8·53 per cent., had been reduced to 4·8 per cent., and that over a total of upwards of 84 miles of gas-mains. He believed that the benefit arising from the reduction in the price of gas would be felt very much more in the coming year, and that the undertaking, which, with its capital of £311,976, had handed over to the district fund during the past five years no less a sum than £45,000, would continue to be a profitable undertaking to the ratepayers. Mr. M'Quaid referred to the reduction in the leakage, and said that considering a large number of new mains had been laid down, and many others repaired or renewed, it was strange the reduction had not been much greater. Mr. Holmes replied that, when the Corporation acquired the works in 1874, the leakage, over a surface which did not amount to half what it was now, amounted to 20·27 per cent. The report and accounts were adopted.

BOLTON CORPORATION GAS SUPPLY.

At a recent Special Meeting of the Bolton Town Council, Alderman Miles, J.P., the Chairman of the Gas Committee, presented his annual report upon the working of the Gas Department, and the Committee's proposals for the disposal of the profits. At the outset, he said he thought the Committee might be congratulated on the fact that within a few days the department attained its majority; the gas-works having been in the hands of the Corporation for nearly 21 years. Dealing with the balance-sheet he said that this year they had expended on account £5397, most of which was for new buildings and mains. But, in spite of their having put this sum to capital account, the fact really was—when they took into consideration the quantity of gas made—that their capital stood lower; the relative figures being £668 15s. per million cubic feet of gas made last year, and £680 9s. the preceding year. He went farther, and said that, if the plant was being worked at its full producing capacity, the amount would be reduced to £544 per million feet of gas made; and he contended this would compare with the best-managed works in the kingdom. At present they had 160 retorts ready for work, but absolutely standing idle; and their gasholder capacity and mains, together with the purifying power, were equal to the gas which would be made from these. With regard to the revenue account, on the debit side the items for coal and cannel were £47,386—a very slight increase on the previous year. The carbonizing wages were lower by £502 than in the previous year, although they had made an additional 21 million cubic feet of gas. The bad debts were £70 less, which was very satisfactory, seeing they had abolished the deposit system. On the credit side, the statement showed receipts amounting to £99,189, as against £98,877—an increase of only about £310 for gas supplied. This might at first appear rather discouraging, but, from an examination of the books, he found they were increasing at their normal rate of 3¼ per cent. One important factor had been the fine weather; and, owing to the inspectors "taking" the meters three days earlier than usual, they were deprived this year of the credit of £700. On the sale of coke, there had been an increase of £435. Tar was the most unsatisfactory item in the accounts, as during the year they had received under this head £4707 less than in the preceding year. The gross profits amounted to £44,139, or a decrease of £2987; and the net balance at disposal for the relief of the rates was £14,546, or equal to £2 16s. 1d. per cent. upon the capital employed in the works. A sum of £7500 had been placed to reserve fund, instead of £9073, which represented the usual 2½ per cent. on fixed capital. Turning to the working statistics, Alderman Miles mentioned that coal and cannel cost ¼d. per ton more than in the previous year; that unaccounted-for gas was 2¼ per cent. more; that they had 450 more consumers; and that there were 115 gas-engines working. The motion having been seconded, Mr. W. Cooper moved an amendment to the effect that the usual sum of 2½ per cent. on fixed capital be placed to reserve account—viz., £9073, instead of £7500, as proposed by the Committee. This was seconded, and supported by several members; the argument being that a large reserve fund should be built up, so that the price of gas might be reduced. It was also contended that greater efforts should be made to reduce the capital account, which now stood at £523,902—the permanent value of the works and plant in 1892 being given at £362,946. Further, it was said that, from 1886 to 1890, the capital account was reduced by £55,000; while from the latter year to 1893, it had gone up £13,441. Alderman Miles, in reply, contended that the gas-works were worth far more than the amount placed in the books; and he welcomed the increase in the capital account, because it showed they were doing more business every year. The amendment having been negatived, the motion was carried.

Grafton (New South Wales) Gas Company, Limited.—The profits of this Company for the half year ended March 31 last amounted to £266, which, with the balance brought forward from the preceding six months (£133), made £399 available for distribution. From this a dividend at the rate of 6 per cent. per annum has been paid, £50 transferred to the reserve fund, and a similar amount to depreciation—thus leaving a balance of £59 to be carried to the next account. The late floods, it appears, are responsible for having caused a considerable diminution in the profits, through which the dividend is 2 per cent. less than usual. In their report, the Directors take the opportunity of expressing their satisfaction at the skill and energy displayed during this disastrous time by their Manager (Mr. H Hoare), to whose efforts they attribute the result that a greater loss was not sustained. They further recognized his services by making him a present of £10.

THE WORLD'S PETROLEUM SUPPLY.

[From the *Board of Trade Journal*.]

Petroleum is produced in various countries, either in its raw state springing from natural sources—as, for example, in the United States, Russia, Canada, the Dutch East Indies, Austria, Roumania, Peru, the Argentine Republic, and Ecuador—or produced by the distillation of bituminous schist, as in Italy and France. Up to the present, the United States has been the most important centre of the petroleum production. The *Moniteur des Intérêts Matériels* says that statistics establishing the yield during the last months of 1892 seem to indicate a gradual exhaustion of the sources, as the average monthly supply in 1892 was only 87,711 gallons, compared with 94,980 gallons in 1891. On the other hand, the production of raw petroleum in 1891 and 1890 was respectively 34,000,000 and 45,000,000 barrels; or a falling off of 11,000,000 barrels in 1891. In spite of this, the exports of petroleum, raw and refined, have followed, thanks to the employment of tank steamers, an ascending scale, and amounted to 740,905,237 gallons in 1892, as compared with 667,000,000 in 1891. In spite of the diminished production, the prices, instead of rising, have experienced a fall, owing to the keen competition of Russian with American petroleum. Hence the abandonment of certain springs in the United States.

At Baku, in Russia, the production is very great, and even exceeds the demand. No greater proof of this fact can be evidenced than the low prices lately quoted—viz., ¼ copeck per poud (36 lbs. avoirdupois) for raw petroleum, and 7 copecks, free on railway trucks, for refined petroleum. During the first nine months of 1892, the production of raw petroleum in the Apsheron Peninsula amounted to 213,560,157 pouds, as compared with 213,056,000 pouds for the corresponding period of 1891. The present depressed condition of the petroleum market in Russia will be improved, it is expected, by the formation of the Syndicate that has been constituted by the seven principal producers of petroleum at Baku under the presidency of MM. Nobel Frères. With respect to petroleum production at Baku, Mr. P. Stevens, Her Majesty's Consul at Batoum, in a report to the Foreign Office, dated March 1, states that an oil-well has recently commenced to flow at Baku, which, at its present rate of production, considerably exceeds the daily output of all the largest wells that have hitherto been in activity in the Apsheron Peninsula. It is estimated that the well in question is delivering as nearly as possible 1,000,000 pouds, or 17,742 tons, of crude oil a day; but, owing to the almost insurmountable difficulties experienced in getting a flow of this magnitude under control, most of the oil is running to waste into an adjoining lake known by the name of Romani. The well is situated from a quarter to half a mile farther eastward on the peninsula than any of the other wells; and, it would appear, opens up a fresh territory, comprising several hundred acres of land, from which no oil has yet been extracted.

From the point of view of the importance of the production, the petroleum supplies of Canada take the third place. From Jan. 1 to Nov. 30, 1891, 192,700 barrels of raw, and 248,025 barrels of refined petroleum were exported. During the same period of 1892, these shipments amounted to 182,371 and 279,823 barrels respectively—a total production in the first eleven months of 1891 equivalent to 805,687 barrels, and in 1892 to 917,561 barrels of raw petroleum. Petroleum has been found in Quebec, Nova Scotia, and New Brunswick, and particularly in the North-West territories, where it seems certain that there is an immense unexplored oil region. It is, however, in the county of Lambton, Ontario, that most of the oil has been, and still is, obtained. The township of Enniskillen is one of the largest oil-producing districts; and the oil is obtained there at a depth of from 370 to 500 feet. The first flowing well was struck in February, 1862; and, before October of the same year, there were no less than 35 wells. As there was no accommodation for the storeage of this enormous flow, there was a frightful amount of waste; and it is calculated by one authority that, between the dates mentioned, no less than 5,000,000 barrels of oil floated off on the water of a neighbouring creek.

The petroleum supplies of the island of Sumatra have only recently been exploited. The product of one district amounted to 20,000 10-gallon boxes in a year. According to the most recent analyses, the Langkat petroleums are of excellent quality; and, moreover, they are derived from lands the extent of which is forty times greater than those in Russia.

According to official statistics, published by the Austrian Minister of Agriculture, there were in Galicia, in the year 1891, 199 establishments engaged in the production of petroleum, and 79 ozokerite mines, supplying together a total quantity of 93,875 tons, of an estimated value of £491,000.

In Italy and France, petroleum is obtained by the distillation of bituminous schist. In 1891, the Italian production was 1155 tons of petroleum; while in France the amount of the product for 1889 was 194,000 tons, as compared with 174,000 tons in 1888.

The yield in Roumania barely attains a value of £2400, although this amount might easily be increased, seeing that there are vast numbers of beds from which it can be obtained, and that the oil itself is of excellent quality. The explanation of the small supply lies in the fact that the Government insists, in the case of Crown lands, upon the payment of a royalty immediately upon the signing of the contract, and even before any petroleum has been found.

The petroleum beds in Peru are of vast extent, and are beginning to attain considerable importance. The London and Pacific Petroleum Company have works extending over a distance of two miles along the coast, and own 26 pits which are in working, having a depth of from 70 to 500 feet, and producing 900 barrels a day.

In the Argentine Republic, 12 pits have been sunk in the department of Lujan, in the province of Mendoza, of which three have yielded excellent results. The Company working these mines since 1890 have produced about 1500 tons of petroleum.

At Cachenta, in the province of Mendoza, in the Argentine, a considerable petroleum industry has sprung up during the last two years. In this district there is a promise of great mineral wealth; but as yet it has been worked only in a desultory manner. There seems to be a future before the petroleum industry. Up to the present time, three

successful borings have been made; and the total output since the first boring in April, 1890, has been 1500 tons. The oil is conducted through pipes to the storeage-tanks at San Vincente. It finds a ready sale at the Rio Cuarto and Mendoza Gas-Works, and on the Argentine Great Western railroad. This railroad has twelve locomotives which use the oil as fuel.

In the republic of Ecuador, numerous petroleum beds are known to exist; and these are of considerable extent. In certain places the oil springs from the ground, and forms pools and streams, which eventually find their way into the sea. A Syndicate has recently been formed, with the object of obtaining the concession of these sources of petroleum, the product of which is said to be of a very good quality.

In British Burma, it appears that there are now 602 petroleum wells—an increase of 92 since 1888; but there are distinct signs of exhaustion. The fact that the aggregate production of the richer wells has fallen off, while that of the poorer ones has increased, although many new wells have been opened, is regarded as the surest indication of the approaching decline in the industry. The drilled wells worked by the Burma Oil Company and the Burma Oil Syndicate have given very satisfactory results. In 1890 the total out-turn amounted to upwards of 3,670,000 viss; but the rate of progress during 1888, 1889, and 1890 has not been maintained during the past two years. The history of the industry shows that the production of the oil-field steadily increased from the beginning of the century until about 1873, when it began to decline—rising again in 1885, and coming practically to a standstill in 1891.

Exhibitions of Gas Appliances.—From Wednesday to Friday of last week, Messrs. W. Parkinson and Co. held an exhibition of their various stoves and other domestic gas appliances at the Ledbury Town Hall. Lectures (which were well attended) were delivered twice daily by Miss Sanderson, of the National School of Cookery.——A varied collection of the gas stoves and appliances made by Messrs. T. Fletcher, Russell, and Co., Limited, has recently been exhibited in the Volunteer Drill Hall at Woking; and the cookery demonstrations in connection therewith were undertaken by Mrs. C. Russell. Messrs. D. Hulett and Co., Limited, furnished a stall with gas-fittings.——An exhibition of the goods manufactured by Messrs. Richmond and Co. has lately been held at Bolton; and the cookery lectures were entrusted to Miss Owen, of the South Kensington School of Cookery.——During the past week, Messrs. R. and A. Main have held exhibitions in the Literary Institute, Edinburgh, and in the Central Hall, Leith; and Messrs. Richmond and Co. have occupied the Leith Assembly Rooms. In the course of the next five or six weeks, there will be a continuous succession of exhibitions by different makers in the Edinburgh district.

Pernambuco Water Company, Limited.—A meeting of the bondholders of this Company was held last Wednesday, at Winchester House, Old Broad Street, E.C., to receive and consider the report of the Committee appointed on July 29, 1892. Mr. R. H. C. Harrison presided. He stated that the Committee had made an exhaustive inquiry into the affairs of the Company, and had found that default in the payment of interest and redemption of the bonds was due to the following causes: Fall in exchange; slow growth of revenue, owing to non-registration of consumers' meters; extravagant working expenses, caused by incompetent management; and improper application of the surplus of revenue over working expenses to the preparation of plans for new works, and the purchase of properties for the same. The Company had been, he said, disgracefully mismanaged; the working expenses rising in five years from 36 to upwards of 60 per cent. More than 122,000 milreis had been spent on new works out of revenue which belonged to the bondholders. Mr. Brown, one of the Committee, said he had gone into the details, and was of opinion that there was no necessity to buy a large number of properties. The receipts of the Company from the year 1883-84 to the present time showed a fairly progressive revenue; and for the year 1891-92 they ought really to have had a net balance of 133,000 milreis, a great deal of which had gone in extravagant working expenses. The only course they could adopt was to force the Company into liquidation, in order to get a receiver appointed by the Courts; but there were many reasons why this course should not be followed. After some discussion, the following resolution was unanimously passed: "That the report of the Committee and their action in appointing Mr. Paterson to represent the bondholders be approved; and that the matter be left in their hands to make the best arrangement in the interest of the bondholders."

The East London Water Company and their Consumers.—At the Thames Police Court, last Thursday, Mr. George Kebbell, Solicitor to the East London WaterWorks Company, renewed his application for summonses against certain ratepayers for non-payment of their water-rates (see *ante*, p. 893). In doing so, he called the Magistrate's attention to section 70 of the Water-Works Clauses Act, 1847, which provided that water-rates were to be paid quarterly in advance. Section 74 of the same Act enacted that, if any ratepayer neglected to pay "at the said times of payment"—*i.e.*, in advance—the Company might cut off and sue him to recover the rate, together with the cost of cutting off. Mr. Dickinson said he felt some difficulty in summoning the persons and ordering them to pay for what they had not received. Mr. Kebbell should go to the County Court, where the cost would be cheaper, and the proceedings more expeditious. From the County Court, there could be a direct appeal; and a police-court was not the proper place in which to try such cases. Mr. Kebbell, with great respect, differed, as the words of the section did not admit of any doubt. It clearly stated that the rate should be paid in advance—just the same as a person taking a railway ticket. In answer to the Magistrate, Mr. Kebbell said that the recovery of the rates was provided for in the Water-Works Clauses Act. If it were the law for the Company to wait three months, instead of having the money in advance, then they would be deprived of the use of many thousands of pounds for that period. Mr. Dickinson observed, on the other hand, that persons might be put to considerable inconvenience if, through drought, for instance, the Company were unable to give any supply; and why should consumers be more inconvenienced than the Company? Mr. Kebbell said this was the law. Mr. Dickinson promised to give his decision in a week.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

What are "the usual occupations of a gas-works?" I put the question because of a difference which has arisen between the Inverness Corporation and an Insurance Company with whom they had insured their workmen. A week or two ago, a fatal accident occurred in the Corporation Gas-Works, while workmen were engaged in the taking down of an iron gasholder tank. Claims having been made upon the Corporation in respect of the accident, the Insurance Company are disputing liability to meet them, in respect that the work the men were engaged upon was not what they had agreed to cover—viz., the usual occupations of a gas-works. The question is a thorny one. On the one side, it may be said that the removal of worn-out plant is a usual occupation in a gas-works; while, on the other, it is scarcely a risk which an Insurance Company would have taken into account when issuing the policy, unless it had been specially stated. It will be interesting to know how the point is decided. If the Corporation have their claim made good, the decision will go far to rule other cases that may arise; but if they fail, all who have workmen insured will require to have their policies revised at the end of the year, so as to keep them safe against extraordinary accidents.

The Dundee Gas Commission, which started the past year with a debit balance of £4780, increased their revenue during the year by £1800, derived from the additional 1d. per 1000 cubic feet which they imposed; and they closed the year with a credit balance of about £250. The estimated surplus was £220; and the result shows careful financing. A reduction in the price of gas is expected.

A new Company has been registered this week, which proposes to take over the undertaking of the Innellan Gaslight Company, Limited, in liquidation. The office of the new Company is at 173, St. Vincent Street, Glasgow; and the capital is £1000, in shares of £10 each.

Mr. H. Pooley, lately of Birkenhead, the newly-appointed Manager of the Dunfermline Gas Company's works, has taken up his position at Dunfermline. One of his first duties was to assist the Directors in the letting of the contracts for the erection of the new works, on the site in Grange Road, to which the entire gas-making establishment is to be transferred. The works are to be built from plans by Mr. T. Newbigging, M.Inst.C.E., of Manchester; and they will cost about £17,000. They are to be of 100 million cubic feet a year capacity. As the present output is about 70 million cubic feet, the surplus capacity is not great; but the site is a large one, and the buildings are so arranged that extension, when required, will be easy. There will, for the present, be eight settings of eight retorts each, fixed upon the regenerative system. Ample room is provided in the retort-house to give accommodation for working, and to ensure good ventilation. The dimensions are: Length, 112 ft. 6 in.; width, 64 ft.; height of walls, 31 ft.; and height to ridge of roof, 53 ft. 6 in. Coal will be delivered into the coal-store alongside the retort-house from a high-level railway siding. In the purifier-house, the purifiers, four in number, will be one storey up; the ground-flat being the lime-store. Hydraulic power will be used for raising the purifier covers. The exhauster will be of 25,000 cubic feet per hour capacity. The scrubber is a tower one, 40 feet high; and there is to be an underground tar well. When the works are completed, they will be as well equipped as any in the smaller towns of Scotland.

In the end of last year, I mentioned that the town of West Calder, in Mid-Lothian, was devoid of lighting at night. There is a prospect of the reproach being removed, as the local Co-operative Society—which is, in a sense, the community—have offered to supply current for electric lamps free of charge. The store premises are already lighted by electricity. A meeting of the inhabitants has been held, at which it was stated that the price of five arc lamps would be £85; and the annual cost of upkeep would be from £12 to £14. An endeavour is to be made to raise funds by subscription. This is but the town paying for the work in another way than by taxation. It is amazing to see such folly exhibited by a community in the county of Edinburgh, as was shown when the adoption of the Police Act was mentioned. This, it was stated, was strongly opposed, because of the heavy increase there would be in the rates. In this matter of lighting they will probably pay more than they would if they assessed themselves for it; and it is almost a certainty that the work will not be so well done by an irresponsible Committee, as by a responsible Board.

How can the vagaries which are contained in the reports of electrical engineers be explained? In his report to the Edinburgh Corporation, Professor Kennedy stated that in London the cost of an 8-candle power lamp per annum in a hotel or club is about 20s.; in a shop, about 8s. 6d.; and in a private house, about 5s.; and he advised the Corporation that they would probably be able to derive a revenue of 8s. 6d. per lamp. When he was in Aberdeen recently, the Directors of the Northern Co-operative Company consulted him about the fitting up of a private electrical installation in their premises. After visiting the place, he has reported to the Directors that they might maintain a light of 500 lamps in them at a cost of from £260 to £270 per annum. This works out at 10s. 9½d. per lamp. Is the difference in cost to be accounted for by the smallness of the installation? If so, what becomes of the statement sometimes made, that a private installation is cheaper than taking current from a public body? There is another curiosity in the report. It is said that the present gas bill of the Company is on an average £220 a year; and that, were the charge for the lighting by gas of new premises which they have built, and which the electric installation is intended to cover, added, it would be £320 a year. This is surely a direct reversal of the theory, almost universally accepted, that electric lighting is two or three times dearer than lighting by gas. These appear to be anomalies in the report which it is well should be pointed out while the Directors still have the subject under consideration.

Mr. Waddell, Manager of the Tain Corporation Gas-Works, having been appointed Manager of the Blairgowrie Gas Company's works, 24 applications have been sent in for the post at Tain; and from these a short leet of four has been selected. Mr. Waddell has only been about a year at Tain; but in that time he has effected great improvements on the works.

A Glasgow newspaper announces that gas and water tubes were probably never cheaper; and that it is thought the masters will be obliged to meet and consider whether they could not, by combined effort, do something to raise prices. I do not place much reliance upon the latter part of the statement.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May 27.*

Sulphate of Ammonia.—It was only to be expected that, being a broken week, business would be hampered; and orders have been kept in abeyance pending the reopening of the works next week. Actual transactions have consequently been limited; but supplies for prompt and near delivery are scanty. The steady tone of the market is well preserved; and the prices remain unchanged. It is not unlikely that presently there will be an increased demand for the Continent; and, as colonial buyers have not yet completed requirements, at least a maintenance of current values may safely be reckoned on. Scotch forward business is reported at £11 15s. to £11 17s. 6d.; but only small quantities have changed hands thereat. Nitrate is quiet; and the value to-day is 8s. 9d. per cwt.

LONDON, *May 27.*

Tar Products.—There is a slightly improved feeling in the market for tar products; and this applies more particularly to benzol, which has been better inquired for—buyers, indeed, showing considerable anxiety to secure parcels for forward delivery. Pitch and anthracene continue at about last week's rates; but, notwithstanding the warm weather, buyers are pressing for full deliveries against contracts. Disinfectants have also been in greater demand; and business in carbolic acid and carbolic crystals has been fairly active. Creosote and oils are at a low ebb; but, with the lessened production, some slight improvement might be looked for. To-day's prices are: Tar 12s. Pitch, 23s. 6d. Benzols, 90's, 1s. 5½d.; 50's, 1s. 4½d. Solvent naphtha, 11½d. Toluol, 1s. 4d. Crude benzol naphtha, 30 per cent., 7d. Creosote, 1d. Creosote salts, 17s. Carbolic acid, 60's, 2s. 4d.; 70's, 2s. 10½d.; crystals, 7½d. Cresol, 1s. 10d. Anthracene, nominal, 30 per cent. "A," 1s. 1d.; "B," 9d.

Sulphate of Ammonia is irregular, although on the whole better. London delivery is spoken of at £12 5s.; whereas Hull is noted at £11 13s. 9d., less 3½ per cent. The position of sulphate is by no means a weak one, having regard to the supply and demand. Gas liquor, 10-oz., is quoted at 7s. 6d. to 8s. 6d. per ton.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is practically little or nothing to report, as regards business in the coal trade of this district during the past week; the collieries having been closed for the holidays. Except some little extra buying on the part of consumers anxious to get in supplies prior to the holidays, the general condition of trade has remained without improvement—stocks accumulating in all descriptions of round coal—and prices continue weak. In best Wigan Arley coals, it is only on very small quantities that more than 11s. is being got; Pemberton four-feet and second qualities of Arley fetch about 9s. 6d.; common house-fire coals, about 7s. 6d.; and the lower qualities of round coal, about 6s. 3d. to 6s. 6d. for inland sales, and 7s. 6d. to 8s. per ton for shipment. The tenders for gas coal contracts continue to be cut very low, and are generally based on a reduction of quite 9d. to 1s.; while in some instances, to secure contracts, concessions of 1s. to 1s. 6d. per ton are being made upon the prices obtained last year. There is an increasing scarcity of engine fuel, owing to the very restricted quantity of round coal now being secured; and consumers in many cases are having to obtain supplies of through-and-through coal, which can be bought relatively very cheap—ordinary sorts being obtainable at about 6s. 3d. to 6s. 6d. Good qualities of burgy average 6s. to 6s. 9d.; best qualities of slack, 5s. 3d. to 5s. 9d.; and common sorts, about 4s. to 4s. 6d. per ton at the pit mouth.

Northern Coal Trade.—Stocks of coal having been somewhat depleted by the recent holidays, a better demand has been experienced. It is, however, one that is more than met by the producing facilities; and now prices are on the whole rather easier, though heavy shipments of coal are being made. Best Northumbrian steam coals are 8s. 7½d. per ton f.o.b.; but one or two collieries ask slightly more, and possibly a little less may have been taken in one or two cases. Second-class coals are 8s. to 8s. 3d.; and small steam coals are now quoted about 3s. 6d. per ton. Manufacturing coals are in limited demand. For gas coals, there are rather more exports, all the Baltic ports being practically open. Some of the great gas companies show signs of stocking coals earlier, as there may be labour troubles a little later. Best Durham gas coals are quoted from 6s. to 6s. 3d. per ton f.o.b., though for one or two kinds, a much higher price is asked. Best Durham coke is in rather fuller demand for the north-west, where one or two additional furnaces are to be put into operation. The price for shipment varies from 13s. to 14s. f.o.b. Gas coke is unaltered in price; but the limited output should reduce the stocks, which are heavy still at some of the inland companies' works.

Scotch Coal Trade.—There has been a slight improvement in prices in Scotland this week. On Monday, a reduction of 6d. per day in miners' wages in the West came into operation; and though the men met that day and protested against the reduction, they did not adopt a strike policy, but resolved to put off coming to a decision for a fortnight. Business has been more active since the reduction. Ell coal still stands highest in the matter of demand, and splint has looked up a little; but the other varieties have not moved. The prices quoted are: Main, 5s. 6d. to 5s. 9d.; ell, 6s. 6d. to 7s.; splint, 6s. to 6s. 3d.; and steam, 7s. 9d. to 8s. per ton f.o.b. Glasgow. The shipments for the week amounted to 139,441 tons—an increase on the preceding six days of 755 tons, but a decrease as compared with the corresponding week of last year of 46,041 tons. For the year to date, the total exports have been 2,389,876 tons—a decrease upon the exports for the same period of last year of 267,827 tons.

Cleckheaton Local Board Gas Undertaking.—The annual report of the Manager of the Cleckheaton Gas-Works (Mr. G. H. Niven) states that the gross profits amount to £3139, as against £3249 in the previous twelve months. No charge is made for lighting the public lamps; and the cost of this work is estimated at £350.

Suggested Reduction in the Quality of the Gas Supply at Leeds.—The *Yorkshire Post* says: "Experiments have been proceeding for the last six or seven months at the various gas-works of the Leeds Corporation, with the object of ascertaining what saving might be effected by discontinuing the use of cannel coal altogether, or by largely reducing the quantity. The result of these trials will, it is understood, shortly be placed before the City Council in the shape of a detailed report from the Gas Committee. It is probable that the Committee will submit with the report a resolution asking the Council to sanction a reduction of the nominal standard of 19½ candles (which, by the way, has never been reached since the Corporation adopted it) to 18½ candles. As a sort of set-off to this suggestion, and as a consolatory sop to the Council and the public, it will very likely be suggested that the sulphur impurities, which now average 15 grains per 100 cubic feet of gas, be reduced to 9 or 10 grains. Rumour says that, if these proposals are brought forward, they are likely to meet with considerable opposition. It can hardly be claimed for the recent experiments, initiated to show what may be accomplished without cannel coal, that they have been a success; for all the time that the trials have lasted proportions of from 5 to 15 per cent. of cannel have been used at all the gas-works in the city. Then, too, though an effort is to be made to prove that several thousands of pounds have been saved by the partial disuse of cannel coal, attention will probably, on the other hand, be directed to the fact that part of the saving during the last six months has been due to a fall in the price of fuel. Usually, when complaints are made as to the quality of the gas supply, endeavours are made to cast the blame upon burners and other fittings. But the inhabitants have suffered inconvenience so long from variations in the pressure and the quality of their gas, that they are now pretty well able to gauge both the quantity and the quality of the supply. Complaints of want of pressure and fitfulness of supply are coming from many districts of the city; and in some neighbourhoods the laying of larger mains is imperatively necessary."

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 996.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apl.	10½	Alliance & Dublin 10 p. c.	10	17–18	..	5 16 8
100,000	10	"	7½	Do. 7 p. c.	10	12–13	..	5 15 5
300,000	100	3 Jan.	5	Australian (Sydney) 5 % Deb.	100	104–106	..	4 14 2
100,000	20	30 Nov.	8	Bahia, Limited	20	11–12	..	13 6 8
200,000	5	12 May	6½	Bombay, Limited	5	5¼–6*	..	5 8 4
40,000	5	"	6½	Do. New	4	3¾–4¼*	..	6 2 6
380,000	Stck.	24 Feb.	11½	Brentford Consolidated	100	216–220	..	5 4 7
180,000	"	"	8½	Do. New	100	168–173	..	4 18 3
220,000	20	15 Mar.	11½	Brighton & Hove Original	20	41–43	..	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	104–107	..	4 13 5
320,000	20	13 Apl.	11½	British	20	42–44	..	5 4 7
50,000	10	15 Mar.	11½	Bromley, Ordinary 10 p. c.	10	19–20	..	5 15 0
51,510	10	"	8½	Do. 7 p. c.	10	14½–15½	..	5 9 8
328,750	10	—	—	Buenos Ayres (New) Limited	10	5¾–6¼	..	—
200,000	100	3 Jan.	6	Do. 6 p. c. Deb.	100	97–100	..	6 0 0
150,000	20	24 Feb	8	Cagliari, Limited	20	25–27	..	5 18 6
550,000	Stck.	28 Apl.	12½	Commercial, Old Stock	100	243–248	..	5 0 10
165,000	"	"	9½	Do. New do.	100	182–187	..	5 1 7
162,762	"	15 Dec.	4½	Do. 4½ p. c. Deb. do.	100	127–132	..	3 8 2
800,000	Stck.	15 Dec.	13	Continental Union, Limited	100	232–237	–2	5 9 8
200,000	"	"	10	Do. 7 p. c. Pref.	100	192–192	..	5 1 6
75,000	Stck.	15 Mar.	10	Crystal Palace District	100	187–192	..	5 4 2
486,090	10	27 Jan.	10	European, Limited	10	21½–22	..	4 8 11
354,060	10	"	10	Do. Partly paid	7½	15–16½	..	1 13 9
5,596,560	Stck.	10 Feb.	12	Gaslight & Coke, A, Ordinary	100	215–220	–2	5 9 1
100,000	"	"	4	Do. B, 4 p. c. max.	100	95–99	..	1 0 10
665,000	"	"	10	Do. C, D, & E, 10 p.c. Pf.	100	263–268	..	3 14 7
30,000	"	"	5	Do. F, 5 p. c. Prf.	100	120–125	..	1 0 0
60,000	"	"	7½	Do. G, 7½ p. c. do.	100	170–175	..	1 5 8
1,300,000	"	"	7	Do. H, 7 p. c. max	100	169–174	..	1 0 5
463,000	"	"	10	Do. J, 10 p. c. Prf.	100	260–265	..	3 15 6
476,000	"	"	6	Do. K, 6 p. c. Prf.	100	156–160	..	3 15 0
1,061,150	"	15 Dec.	4	Do. 4 p. c. Deb. Stk.	100	124–128	..	3 2 6
294,850	"	"	4½	Do. 4½ p. c. do.	100	130–134	..	3 7 2
908,000	"	"	6	Do. 6 p. c. do	100	169–173	..	3 9 4
3,800,000	Stck.	12 May	12	Imperial Continental	100	216–220*	–2	5 9 1
75,000	5	30 Nov.	6	Malta & Mediterranean, Ltd.	5	4¾–5¼	+¼	5 9 1
560,000	100	4 Apl.	5	Met. of Melbourne, 5p. c. Deb.	100	103–105	+1	4 15 3
541,920	20	16 Nov.	5	Monte Video, Limited	20	13–14	..	7 2 10
150,000	5	30 Nov.	10	Oriental, Limited	5	7¾–8¼	..	5 1 2
60,000	5	29 Mar.	7	Ottoman, Limited	5	4–4½	..	7 7 4
166,870	10	—	2	Pará Limited	10	1¾–2¼	..	—
420,000	100	2 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	100–105	..	5 14 3
500,000	100	1 Dec.	6	2nd Do.	100	100–105	..	5 14 3
150,000	10	28 Apl.	5	San Paulo, Limited	10	8¾–9¼	..	5 5 3
500,000	Stck.	24 Feb.	15½	South Metropolitan, A Stock	100	294–299	..	5 3 8
1,350,000	"	"	12	Do. B do.	100	244–248	..	4 16 9
230,000	"	"	13	Do. C do.	100	245–255	..	5 1 11
750,000	"	13 Jan.	5	Do. 5 p. c. Deb. Stk.	100	148–152	..	3 5 9
60,000	Stck.	15 Mar.	11½	Tottenham & Edm'nton, "A"	100	225–230	..	5 0 0
				WATER COMPANIES.				
744,897	Stck.	30 Dec.	10	Chelsea, Ordinary	100	263–268	–2	3 14 7
1,720,252	Stck.	29 Mar.	8	East London, Ordinary	100	208–213	–1½	3 15 1
544,440	"	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	142–145	..	3 2 1
200,000	50	15 Dec.	8½	Grand Junction	50	110–113	–1	3 15 2
708,000	Stck.	10 Feb.	11	Kent	100	280–285	..	3 17 2
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	240–245	–3	3 17 7
406,200	100	"	7½	Do. 7½ p. c. max.	100	199–204	..	3 14 0
310,000	Stck.	29 Mar.	4	Do. 4 p. c. Deb. Stk.	100	129–132	..	3 0 7
500,000	100	10 Feb.	12½	New River, New Shares	100	329–334	..	3 12 8
1,000,000	Stck.	27 Jan.	4	Do. 4 p. c. Deb. Stk	100	133–137	..	2 18 5
902,300	Stck.	15 Dec.	6½	S'thwk & V'xhall, 10 p. c. max.	100	160–165	–5	3 18 9
126,500	100	"	6½	Do. D 7½ p. c. do.	100	145–150	..	4 6 8
1,155,066	Stck.	15 Dec.	10	West Middlesex	100	260–265	–2	3 15 6

*Ex Div.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams "GWYNNEGRAM LONDON."

GWYNNE & CO., TELEPHONE No. 2698.

HYDRAULIC AND GAS ENGINEERS, BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

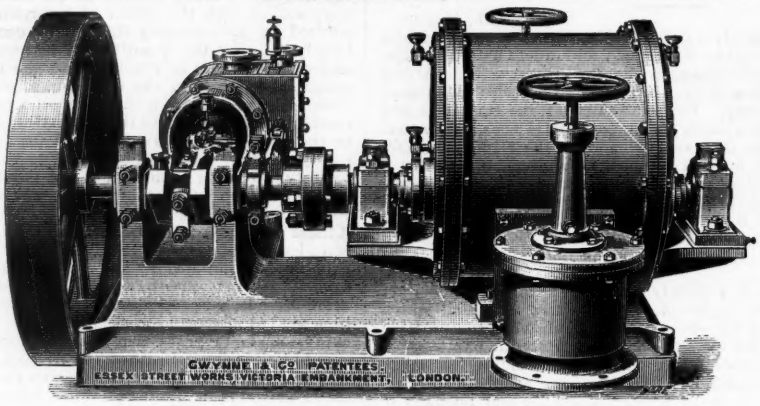
Late Essex Street Works, Victoria Embankment, London, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co., for Gas Exhausters, &c.

They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality.

The result is that in every instance their work is giving the fullest satisfaction.

They have completed Exhausters to the extent of 30,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work, and can be referred to.



Engine and Exhauster Combined on One Bed-Plate.

GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANSING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 189, Gresham House, Old Broad Street, LONDON, E.C.

VOLCANIC Fire Cement (Winkelmann's)
Fire Resistance 4500° Fahr.
ANDREW STEPHENSON, Sole Agent, 189, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

GAS-WORKS Design, Construction, or Management. Engagement wanted as PRINCIPAL or ASSISTANT. Many years' experience at home and abroad.
For terms and references, apply to F. G. COCKEY, Wh.Sc., Stoke House, FROME.

YOUNG Man (23) seeks Situation in Gas- Works, home or abroad. Nine years' experience (Seven articled to Manager). Is a good Draughtsman, Chemist, and Photometrist, and can keep books. First-class testimonials.
Address, No. 2239, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Situation as Manager of a Tar Distillery, at either a Gas-Works or Private Yard. Advertiser has a thorough practical knowledge of every branch of Tar Distilling and Ammonia Making. Could undertake erection of a new Plant.
Address J. LIGHTFOOT, 8, Christ Church Terrace, ACCRINGTON.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield; AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. III., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

PATENTS, DESIGNS, AND TRADE MARKS.

INVENTIONS Protected by Letters Patent. TRADE MARKS REGISTERED at home and abroad. Advice on all questions relating to above. Handbook gratis.
Apply to J. C. CHAPMAN, Chartered Patent Agent, 70, Chancery Lane, LONDON.

WANTED, a Situation as Foreman GAS-FITTER. Over 25 years with Gas Company in a Large Manufacturing Town. Thorough knowledge of Gas Cooking-Stoves, Wet and Dry Meters, Fittings, &c.
Address No. 2240, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

COMPETENT Tar Still-Man wanted, at once.
Address TALK O' TH' HILL COLLIERY, Talke, STOKE-ON-TRENT.

WANTED, immediately, a good Main and SERVICE LAYER.
Forward testimonials to No. 2233, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BOROUGH OF MANSFIELD.

THE Mansfield Corporation invite APPLICATIONS for the post of MANAGER (now vacant) for their Gas-Works, with a supervision of the Water-Works, at a salary of £150 per annum, with House, Gas, and Coal.
Any further information may be obtained from, and all applications in Candidates' handwriting, accompanied by not more than Three recent Testimonials, and stating age and the time when he can commence his duties, must be sent in to me, the undersigned, before Monday, the 5th day of June, 1893, endorsed "Application for Manager."
Canvassing any Member of the Council will be a disqualification.

R. J. PARSONS,
Town Clerk.

Mansfield, May 17, 1893.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals,
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore. Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; 10, Marsden Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA, SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

LIQUOR and Tar wanted.
BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

WANTED, a Young Man as Meter INSPECTOR. State lowest wages and experience.
Forward testimonials to No. 2234, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a first-class Traveller for the English Gas Coal Trade in the Midlands. Liberal terms to one with good connection.
Address No. 2235, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a practical Working Fore- man, thoroughly experienced in both Wet and Dry Gas Meters and Apparatus.
Apply, stating age, &c., to W. NASH, Manager, Gas-Meter Company, Limited, Union Street, OLDHAM.

TRAVELLER or Agent Wanted, on Commission, with first-class connection among Gas Companies in the South, Midlands, and North of England. Liberal Terms.
Address No. 2236, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, 5000 cubic feet per hour Combined ENGINE and EXHAUSTER. State condition and lowest price.
Address No. 2232, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—A Station Meter, in Circular Case, with Bye-Pass, &c., complete, to pass 9000 cubic feet per hour.
Apply to G. E. SAVILLE, Gas-Works, TODMORDEN.

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.
For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

RAILWAY TANK-WAGGONS.

THE Advertiser is prepared to Sell or LET ON HIRE two RAILWAY TANK-WAGGONS, nearly new. Suitable for Tar or Gas Water, &c.
Address No. 2237, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE — 28 Vols. of the British ASSOCIATION OF GAS MANAGERS and GAS INSTITUTE TRANSACTIONS from 1863 to 1891. Also 2 Vols. of REPORT ON GAS SECTION of ELECTRIC AND GAS EXHIBITION OF 1882-3. What offers?
Address No. 2238, care of Mr. King, 11, Bolt Court FLEET STREET, E.C.

FOR SALE—(1) Combined Engine and EXHAUSTER, with Compensating Hydraulic Governor (Laidlaw); passes 7500 cubic feet per hour. (2) STATION GOVERNOR (Milne); 8-in. Connections.
The above are being displaced, in consequence of extensions, and can be seen at the Gas-Works, Portobello, N.B.
DAVID VASS,
Manager and Secretary.

TENDERS FOR GAS COAL.

THE Directors of the Victoria New- market Gaslight and Coke Company, Limited, invite TENDERS for the supply of 4500 tons of best screened GAS COAL during the ensuing Twelve Months ending June 30, 1894.
Tenders, stating price per ton, delivered free at Newmarket Station as required, to be sent to the undersigned, on or before the 2nd of June, 1893, from whom any further particulars may be obtained.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
J. H. TROUGHTON,
Manager and Secretary.
Gas-Works, Newmarket,
May 19, 1893.

GLASGOW CORPORATION GAS.

TENDERS FOR METERS.

THE Gas Corporation of Glasgow invite TENDERS for the supply of such METERS (Dry and Wet) as they may require for Twelve Months from the 1st of June next.
Forms of Tender may be had on application to the Manager, at the Gas Office, 45, John Street, Glasgow; and sealed Offers, marked "Tender for Meters," to be addressed to and lodged with the Subscriber on or before Tuesday, the 6th prox.
The Corporation do not bind themselves to accept the lowest or any offer.
J. D. MARWICK,
Town Clerk.
City Chambers, George Square, Glasgow,
May 15, 1893.

SHREWSBURY GASLIGHT COMPANY.

DISPOSAL OF SURPLUS TAR.

THE Directors of the above Company are desirous of receiving TENDERS for the purchase of the surplus TAR made at their Works during the Year commencing July 1, 1893.
The estimated quantity for disposal is about 950 tons per Annum.
Tenders must be made on Forms (containing further particulars), which may be obtained on application at the Company's Works, or by post, and must be sent in to the undersigned not later than the 17th day of June, 1893.
The Directors do not bind themselves to accept the highest or any tender.
By order,
WM. BELTON, Assoc.M.Inst.C.E.,
Secretary and Manager.
Gas-Works, Shrewsbury,
May 18, 1893.

SHREWSBURY GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the Shrewsbury Gas- light Company invite TENDERS for the supply of about 13,000 tons of GAS COALS, and about 1000 tons of good ENGLISH CANNEL, to be delivered free at the Great Western or London and North-Western Goods Yard, Shrewsbury, during the Year commencing July 1, 1893, and ending June 30, 1894.
The Directors reserve to themselves the right to divide the quantity into two or more Contracts, and do not bind themselves to accept the lowest or any tender.
Tenders must be made on Forms (containing further particulars), which may be obtained on application at the Company's Works, or by post, and must be sent to the undersigned, on or before the 17th day of June, 1893.
By order,
WM. BELTON, Assoc.M.Inst.C.E.,
Secretary and Manager.
Gas-Works, Shrewsbury,
May 18, 1893.

GREAT WIGSTON GAS COMPANY.

TO CONTRACTORS, IRONFOUNDERS, ETC.

THE Directors of the above Company are prepared to receive TENDERS for the delivery and laying complete of about 1620 yards of 15-inch CAST-IRON SOCKET AND SPIGOT PIPES.
For Specification Forms of same, apply at once to the undersigned.
JOHN A. HARRIS,
Engineer and Manager.

BOROUGH OF OLDHAM.

THE Gas-Works Committee invite TENDERS for the TAR and AMMONIACAL LIQUOR to be produced at their different Gas Stations for a period of One Year, commencing the 1st of July next.
The yearly make of Tar is about 6400 tons; and of Ammoniacal Liquor, about 2,400,000 gallons.
Particulars and Forms of Tender can be obtained on application to Mr. Herbert Andrew, Gas and Water Offices, Oldham, to whom tenders are to be sent on or before Tuesday, the 13th of June, 1893.
A. NICHOLSON,
Town Clerk.
Oldham, May 24, 1893.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO ENGINEERS, ETC.

THE Gas Committee are prepared to receive TENDERS for the supply and erection of an EXHAUSTER (70,000 cubic feet per hour capacity) for their Portwood Works.
Full Details and all Information can be obtained on application to the Engineer, Mr. S. Meunier, Stockport.
Tenders, endorsed "Exhauster," and addressed to the Chairman of the Gas Committee, to be sent in on or before the 8th of June, 1893.
No tender will be accepted without satisfactory proof that the firm tendering pays the standard rate of wages, and observes the standard number of hours.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
WALTER HYDE,
Town Clerk.
Stockport, May 24, 1893.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TENDERS FOR TAR AND AMMONIACAL LIQUOR.

THE Gas Committee invite Tenders for the purchase of the surplus TAR, and the whole of the AMMONIACAL LIQUOR produced at their Works, for a period of One, Two, or Three Years, commencing on the 1st of July, 1893.
Particulars as to quantity and Conditions of Contract may be obtained on application to the Engineer, Mr. S. Meunier, Stockport.
Tenders, endorsed with the subject of tender, and addressed to the Chairman of the Gas Committee, must be sent in on or before the 8th of June, 1893.
The Committee do not bind themselves to accept the highest or any tender.
By order,
WALTER HYDE,
Town Clerk.
May 23, 1893.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

CONTRACT FOR LIME.

THE Gas Committee are prepared to re- ceive TENDERS for the supply of about 2500 tons of LIME during the Year ending June 30, 1894.
Forms of Tender and Specification, together with any further Information, may be obtained from the Engineer, Mr. S. Meunier, Stockport.
No Form of Tender other than that supplied by the Committee will be entertained.
Tenders, stating price per ton delivered on Rails, Stockport, endorsed "Tender for Lime," and addressed to the Chairman of the Gas Committee, must be sent in on or before the 8th of June, 1893.
No tender will be accepted without satisfactory proof that the firm tendering pays the standard rate of wages, and observes the standard number of hours.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
WALTER HYDE,
Town Clerk.
May 23, 1893.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO COLLIERY OWNERS AND OTHERS.

THE Gas Committee are prepared to receive TENDERS for the supply of CANNEL and COAL for a period of One, Two, or Three Years commencing upon the 1st of July next.
Forms of Tender and Specification, together with any further information, may be obtained from the Engineer, Mr. S. Meunier, Stockport.
No Form of Tender other than that issued by the Committee will be entertained.
Tenders, stating price per ton delivered at the Railway Stations, Stockport, endorsed "Tender for Cannel" or "Coal," and addressed to the Chairman of the Gas Committee, must be sent in on or before the 10th of June, 1893.
No tender will be accepted without satisfactory proof that the firm tendering pays the standard rate of wages, and observes the standard number of hours.
The Committee reserve the right to accept tenders for the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.
By order,
WALTER HYDE,
Town Clerk.
May 23, 1893.

BRICK TANK.

TENDERS required for the excavation and construction of a BRICK TANK, 41 ft. 6 in. diameter by 16 ft. deep. The work to be done at the Staveley Gas-Works, Staveley, near Chesterfield.
Plans and Particulars may be had on application to Messrs. WESTWOOD AND WRIGHTS, BRIERLEY HILL.

BOROUGH OF CONGLETON.

THE Gas Committee invite Tenders for the supply of 3000 tons of best screened GAS COAL, 3000 tons of BURGY, and 500 tons of CANNEL, to be delivered between the 1st of July, 1893, and the 30th of June, 1894.
Particulars may be obtained from the undersigned.
Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman of the Gas Committee, to be delivered, at the Town Clerk's Office, not later than Wednesday, June 7.
WILLIAM T. GOODWIN,
Manager.

TAR AND LIQUOR.

THE Gas Committee of the Borough of Congleton are prepared to receive TENDERS for their surplus TAR and AMMONIACAL LIQUOR, to be produced at their Gas-Works from July 1, 1893, to June 30, 1894.
Further particulars may be obtained from the undersigned.
Sealed tenders, endorsed "Tar and Liquor," addressed to the Chairman of the Gas Committee, to be delivered, at the Town Clerk's Office, not later than Wednesday, June 7.
WILLIAM T. GOODWIN,
Manager.

TENDERS FOR GAS COAL AND CANNEL.

THE Directors of the Stretford Gas Company invite TENDERS for the supply of CANNEL and best screened GAS COAL, to be delivered during the next One or Two Years, in monthly quantities as may be required.
Sealed tenders to be sent to the Chairman of the Company not later than June 2, 1893, endorsed "Tender for Coal," or "Cannel."
The lowest or any tender not necessarily accepted.
By order of the Board,
BENJAMIN HAYNES,
Secretary.
Stretford, near Manchester.

THE Directors of the Stretford Gas Company are prepared to receive TENDERS for the supply of the following MATERIALS in such quantities as may be required during a period of One, Two, or Three Years following the acceptance of tender:—
1. Gas-Meters.
2. Brass Main Taps and Keys.
3. Wrought-Iron Tubes and Fittings.
4. Stationery and Printing.
5. Lime.
6. Retort Mouthpieces, Door-Frames, Special Bends, &c.
7. Oils and Cotton Waste.

Further information may be obtained upon application to the Secretary, Gas-Works, Stretford.
Sealed tenders, endorsed "Tender for Miscellaneous Goods," together with Sample of Goods offered, addressed to the Chairman of the Company, Stretford, must be delivered not later than the 2nd of June, 1893.
The lowest or any tender not necessarily accepted.
By order of the Board,
BENJAMIN HAYNES,
Secretary.
Stretford, near Manchester.

HORSHAM GAS COMPANY, LIMITED.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Horsham Gas Company, Limited, invite TENDERS for the supply of about 2700 tons of South Yorkshire well-screened SILKSTONE GAS COAL, and about 150 tons of CANNEL, for Twelve Months, from the 1st of July, 1893, to the 30th of June, 1894.
The Cannel to produce 11,000 cubic feet of 30-candle Gas per ton, and a good saleable Coke.
Both Coals must be free from Bats and Sulphurous Pyrites, or other objectionable matter.
The deliveries are to be made in such quantities and at such times as may be directed by the Manager.
Tenders, stating the price per ton of 20 cwt., delivered free in the Goods Yard, Horsham Station, to be sent to the undersigned not later than Friday, the 9th of June, 1893, and endorsed "Tender for Coal and Cannel."
The Directors do not bind themselves to accept the lowest or any tender.
Any further information may be obtained from
E. D. SAPEY,
Manager.
Gas Offices, Horsham,
May 26, 1893.

HORSHAM GAS COMPANY, LIMITED.

TENDERS FOR TAR AND LIQUOR.

THE Directors of the Horsham Gas Company, Limited, invite TENDERS for the purchase of the surplus TAR and LIQUOR produced at their Works during the Twelve Months from the 1st of July, 1893, to June 30, 1894; the quantity being about 30,000 gallons of Tar and 64,000 gallons of Liquor.
Tenders to state the price per cask of 40 gallons on Rail at Horsham Station, and in such quantities as may be directed by the Company's Manager.
The Liquor to be of 5° Twaddel.
The Contractors will supply all casks.
Tenders to be sent to the undersigned not later than Friday, the 9th of June, 1893, and endorsed "Tender for Tar and Liquor."
The Directors do not bind themselves to accept the highest or any tender.
Any further information may be obtained from
E. D. SAPEY,
Manager.
Gas Offices, Horsham
May 26, 1893.

MATLOCK AND DISTRICT GAS COMPANY, LTD.

OXIDE OF IRON.

THE Directors of the above Company wish to purchase 28 tons of OXIDE OF IRON, to be delivered at the Matlock Bridge Station, on the Midland Railway.

Offers to be delivered to the undersigned not later than the 11th of June next.

ROBERT HALL,
Secretary.

Matlock, May 25, 1893.

MATLOCK AND DISTRICT GAS COMPANY, LTD

TAR AND LIQUOR.

THE Directors of the above Company are prepared to receive TENDERS for the surplus TAR and LIQUOR to be produced at their Works from the 1st of July, 1893, to the 30th of June, 1894.

The estimated quantities will be about 170 tons of Tar, and 800 tons of Ammoniacal Liquor.

The Tar and Liquor to be delivered into the Contractor's Tanks at the Matlock Bridge Station, on the Midland Railway.

The strength of the Liquor to be tested by Twaddel's Hydrometer (temperature 60°); and the tender to state the price per ton from 4° to 8°.

The Tanks to be sent when required.

Payments: 12th of following months.

Sealed tenders, endorsed "Tender for Residuals," to be lodged with the undersigned not later than the 11th of June, 1893.

The highest or any tender not necessarily accepted.

ROBERT HALL,
Secretary.

Matlock, May 25, 1893.

TO LIME MASTERS.

THE Corporation of Walsall invite TENDERS for the supply of about 800 tons of LIME, which will be required at their Gas-Works during One Year from the 1st of July next; the deliveries to be in such monthly quantities as the Manager of the Gas-Works may from time to time direct.

The Lime is to be hand-picked, and clear from Refuse and Ashes, and to be delivered at Walsall Railway Station, or by Boat at the Pleck or Wolverhampton Street Gas-Works. In the former case, it will have to be unloaded.

Payments monthly.

Tenders, sealed and marked outside "Tender for Lime," are to be sent to the undersigned on or before Saturday, the 10th of June next.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 27, 1893.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the supply of 34,000 tons of STAVELEY, YORKSHIRE, or any other good GAS COAL, to be delivered during One Year from the 1st of July next, either at the London and North-Western or Midland Railway Stations at Walsall, or the Corporation Siding at the Pleck Gas-Works as may be required.

Forms of Tender and Specification may be obtained on application to the undersigned.

The Corporation do not bind themselves to accept any Tender; and they reserve the right to divide the Contract between several firms.

Tenders, sealed and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts, are to be sent to the undersigned on or before Saturday, the 10th of June next.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 27, 1893.

TENDERS FOR TAR.

THE Corporation of Walsall invite TENDERS from Persons willing to purchase the surplus TAR made at the Pleck and Wolverhampton Street Gas-Works during One Year from the 1st of July next.

The Corporation will deliver it into the Contractor's Boats at the Gas-Works. Not more than two boat loads will be allowed to remain in the tanks at each Gas-Works at any time.

The price per quantity of 210 gallons to be stated. To be paid for monthly.

Tenders, sealed and marked outside "Tender for Tar," are to be sent to me on or before Saturday, the 10th of June next.

Security will have to be given for the performance of the contract.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 27, 1893.

COUNTY BOROUGH OF BURY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Corporation of Bury are prepared to receive TENDERS for the supply of GAS COAL and CANNEL for One, Two, or Three Years, commencing on the 1st day of July next, to be delivered free at the Corporation Siding, Bury, in such quantities as may be required from time to time.

Estimated quantity, about 27,000 tons of Coal, and 3000 tons of Cannel per annum.

Full Particulars and Form of Tender may be obtained on application to Mr. Gendall, Manager at the Gas-Works, Elton, Bury.

Sealed tenders, endorsed "Tender for Coal and Cannel," to be sent to me, the undersigned, on or before Saturday, June 24, 1893.

The Corporation do not bind themselves to accept the lowest or any tender.

JOHN HASLAM,
Town Clerk.

Corporation Offices, Bury,
May 28, 1893.

BOROUGH OF EAST RETFORD.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of 4000 tons of GAS COAL, to be delivered during the year ending June 30, 1894.

Sealed tenders to be sent in to the Chairman of the Gas Committee, on or before June 3, endorsed "Tender for Coal."

Any further particulars can be had on application to me.

J. B. FENWICK,
Manager.

Gas and Water Office, Retford,
May 18, 1893.

BOROUGH OF EAST RETFORD.

THE Gas Committee of the above Corporation invite TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works during the Year ending June 30, 1894.

Tenders to be sent in to the Chairman of the Committee, endorsed "Tar" or "Liquor."

Further particulars may be had from the undersigned.

J. B. FENWICK,
Manager.

Gas and Water Office, Retford,
May 18, 1893.

THE Middleton Corporation are prepared to receive TENDERS for the supply of 6000 tons of COAL, and 1500 tons of CANNEL, delivered, at the Middleton Railway Station (carriage paid), in such quantities and at such times as the Corporation or their Gas Manager may require.

Sealed tenders, addressed to the Chairman of the Gas Committee, to be delivered at my Office, on or before Wednesday, the 14th of June, 1893, endorsed "Tender for Coal" or "Cannel" as the case may be.

Further Particulars and Form of Tender may be obtained by written application only to Mr. T. Duxbury, Gas Manager.

The Corporation do not bind themselves to accept the lowest or any tender.

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton, near Manchester,
May 24, 1893.

THE Middleton Corporation are prepared to receive TENDERS for about 300 tons of TAR now lying at the Gas-Works, Middleton; also for their SURPLUS TAR for Year ending June 30, 1894.

Coal carbonized, about 8500 tons.

Tenders, addressed to the Chairman of the Gas Committee, to be delivered at my Office on or before Wednesday, the 14th of June, 1893, endorsed "Tender for Tar."

Further Particulars and Form of Tender may be obtained by written application only to Mr. Duxbury, Gas Manager.

The Corporation do not bind themselves to accept the highest or any tender.

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton, near Manchester,
May 24, 1893.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 50,000 tons of best, well-screened, large GAS COALS, to be delivered between July, 1893, and June 30, 1894, in monthly quantities, in accordance with the Specification.

Parties tendering may do so for the whole quantity or for quantities from 5000 tons upwards.

Forms of Tender and Specification of monthly deliveries may be obtained on application to Mr. H. Morley, the Company's Engineer.

Sealed tenders to be sent to the undersigned not later than Thursday, the 8th day of June next, addressed to the Chairman of the Company, and endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
May 10, 1893.

TO CHEMICAL MANUFACTURERS AND OTHERS.

TENDERS FOR TAR AND LIQUOR.

THE Directors of the Gravesend and Milton Gaslight Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR of the Company from the 24th day of June, 1893.

The Contract will terminate on the 23rd day of June, 1894.

The Purchaser will be required to sign a Contract, a copy of which can be seen at my Offices.

The Tar and Liquor will be delivered free into the Purchaser's Barges alongside the Company's Works, which abut on the Thames and Medway Canal above the Lock.

The Purchaser must pay any Canal or other Dues.

Tenders must quote for Tar at per gallon, and for Liquor at per ounce of strength per butt of 108 gallons. Twaddel's test (at 60° Fahr.) will be strictly observed.

The Directors do not guarantee any specific quantity of Tar or Liquor; but there will probably be about from 80,000 to 100,000 gallons of Tar.

Tenders, marked outside "Tenders for Tar and Liquor," sealed and addressed to the Chairman and Directors, Gas Company's Offices, 9, Berkley Crescent, Gravesend, must reach the Offices not later than Tuesday, the 30th day of May inst.

The Directors do not bind themselves to accept the highest or any tender.

Dated this 13th day of May, 1893.

CHAS. R. GRAMSHAW,
Secretary.

Great Wigston Gas Company.

ISSUE OF £2000 NEW ORDINARY STOCK AS ADDITIONAL ORDINARY CAPITAL OF THE COMPANY.

The Directors invite Tenders for £2000 New Ordinary Stock, recently created by the Company under the powers of the Great Wigston Gas Act 1889, and which will be sold in 200 Lots of £10 each.

The purchase-money for each Lot will be payable on the 30th day of June, 1893, and the purchasers will be entitled to share in the profits of the Company from and after that date; but the Stock will carry Dividends at the rate and to the extent of seven-tenths only of the rate of Dividend which shall from time to time be declared in respect of the original Stock of the Company (amounting to £14,000), as provided by Sections 26 and 27 of the said Act. A copy of the Sections referred to is given below.

The Tenders shall state the number of Lots tendered for, and the amount offered for each Lot. The highest bidder shall be the purchaser; but no less price will be accepted than the amount to be stated as the reserved price in a notice to be given by the Company to the Board of Trade, pursuant to the Provisions of the said Act—such reserved price being not less than the nominal value of each Lot. If any offer made by a present Stockholder or Stockholders of the Company be the same in amount as any offer made by any other person, the offer of such Stockholder or Stockholders is entitled to, and will be accepted in, preference.

The Stock will, immediately on payment of the purchase-money, be registered in the names of the applicants or their nominees free of expense.

No greater number of Lots of the present issue will be sold or allotted than will be sufficient, with the premiums, if any, obtained thereon, to raise the sum of £2000.

Tenders sealed up and marked "Tender for New Ordinary Stock" must be sent to the undersigned, the Secretary of the Company, at the Company's Office, Bushloe End, Great Wigston, near Leicester, not later than Four o'clock in the Afternoon of Friday, the 16th day of June, 1893, and may be in the following form, printed copies of which can be obtained on application to the Company's Secretary.

FORM OF TENDER.

I hereby tender for Lots of £10 each of New Ordinary Stock of the Great Wigston Gas Company at the price of
for each Lot. And I agree to accept the said Lots or any less number that may be allotted to me, and to pay the purchase-money to the Company's Bankers, Messrs. Pare's Leicestershire Banking Company, Limited, Leicester, on or before the 30th day of June, 1893.

Dated this day of 1893.

(Name).....

(Address).....

(Description).....

To the Great Wigston Gas Company.

Letters of allotment of Shares will be sent by Post on or before the 20th day of June, 1893, to applicants whose offers are accepted.

By order,
IDDO SAMPSON,
Secretary.

Gas Office, Bushloe End, Great Wigston,
May 17, 1893.

Sec. 26.—"Except as by this Act provided, the "profits of the Company to be divided among the "Shareholders in any year shall not exceed the "following rates (which are in this Act referred to as "the standard rates of dividend)—that is to say:

"On the original stock the rate of £10 in respect "of every £100 of such stock and on the additional "capital to be raised under the powers of this Act "the rate of £7 in respect of every £100 actually "paid up of such capital as shall be issued as "ordinary capital and the rate of £6 in respect of "every £100 actually paid up of such capital as "may be issued as preference capital."

Sec. 27.—"In case in any half year the funds of the "Company applicable to dividend shall be insufficient "to pay the full amount of dividend at the prescribed "maximum rate on each class of ordinary stock or "shares in the capital of the Company a proportionate "reduction shall be made in the dividends of each "class."

FROME GAS COMPANY.

THE Directors of the above Company are prepared to receive TENDERS for the supply of from 500 to 4200 tons of best screened GAS COAL, to be delivered at the Gas-Works Siding between July 1, 1893, and June 30, 1894.

Tenders to be sent to me not later than June 24, 1893, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender.

H. F. VINCENT,
Manager.

Gas-Works, Frome,
May 27, 1893.

PADIHAM AND HAPTON LOCAL BOARD.

THE Gas Committee of the above Board invite TENDERS for the supply of GAS COAL for One, Two, or Three Years. The Coal to be delivered, as required, at the Padiham Railway Station.

For particulars, apply to the undersigned.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Gas Coal," must be sent to me not later than Saturday, June 17, 1893.

By order,
J. R. SMITH,
Clerk to the Board.

Local Board Offices, Padiham,
May 27, 1893.

PETERBOROUGH GAS COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company invite TENDERS for the supply of best screened GAS COAL and NUTS, for One or Two Years, commencing the 1st of July next.

Form of Tender and Conditions may be obtained on application to the undersigned.

Tenders to be sent in by the 12th of June, 1893, endorsed "Coal," and addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

JOHN BARTON,
Secretary and Manager.

Gas-Works, New Road,
Peterborough, May 24, 1893.

OLDBURY LOCAL BOARD OF HEALTH.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of 6500 tons, or thereabouts, of GAS COAL for delivery during the Year ending the 30th of June, 1894, in such quantities and at such times as ordered, carriage free, at the Oldbury Basin of the Great Western Railway Company.

The Coal must be of first-class quality, freshly wrought, and as free as possible from Bats, Pyrites, and other foreign matter.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Gas Coal," to be delivered to the undersigned not later than Saturday, June 10 next.

The Gas Committee do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order.
A. COOKE,
General Manager.

Gas-Works, Oldbury, May 17, 1893.

EDINBURGH AND LEITH CORPORATIONS GAS.

RESIDUAL PRODUCTS FOR SALE.

THE Edinburgh and Leith Corporations Gas Commissioners are prepared to receive separate TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR to be produced at their Works in Edinburgh and Leith respectively during the Three Years from the 1st of July next.

Forms of Tender, on which the offers must be made, and copies of the Terms and Conditions upon which the Products are to be Sold, may be had on application to the Engineers at these Works.

Offers, endorsed "Tender for Edinburgh Works Residual Products" or "Tender for Leith Works Residual Products," will be received by the Subscriber on or before Saturday, the 10th prox.

The Commissioners do not bind themselves to accept the highest or any tender.

JAMES M'G. JACK,
Clerk.

25, Waterloo Place,
Edinburgh, May 19, 1893.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 18,000 tons of GAS COAL for One year, from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price delivered both in Vessel, and at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than Monday, the 5th day of June next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
May 11, 1893.

TENDERS FOR GAS COAL.

THE Directors of the Romford Gas and Coke Company, Limited, invite TENDERS for the supply of Best SOUTH YORKSHIRE, SILKSTONE, or other high-class INLAND COAL for One, Two, or Three Years, in quantities of 3000 tons per Year, dating from the 1st of August to the 31st of July.

Tenders, endorsed "Tender for Coal," and stating price per ton of 20 cwt. delivered free at Romford Station, G. E. R. (as per Schedule to be supplied by the Company), to be sent in on or before June 9, addressed to the Chairman of the Company.

Separate price to be named for each annual quantity.

Payments will be made only on the quantities delivered over the Company's weigh-bridge.

The Directors do not bind themselves to accept the lowest or any tender.

HY. JOHNSON,
Secretary.

Romford, May 27. 1893.

HAVERHILL LOCAL BOARD.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Haverhill Local Board are desirous of receiving TENDERS for the supply of 1000 tons of GAS COAL during the period of One Year from the 1st day of July next.

All persons submitting tenders must state the price per ton of 20 cwt., delivered free to Haverhill Station; and the person whose Tender is accepted will be required to deliver the Coal in such quantities as the Board may from time to time require until the contract is completed.

Sealed tenders, marked "Tender for Coal," should be addressed and sent to me, the undersigned, not later than Tuesday, the 13th day of June next.

CHARLES F. FREEMAN,
Clerk.

Haverhill, May 26, 1893.

CAMBRIDGE UNIVERSITY AND TOWN GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 20,500 tons of CANNEL, best well-screened GAS COAL, and NUTS, to be delivered between the 1st of July, 1893, and the 30th of June, 1894.

Forms of Tender and Specification may be obtained on application to the undersigned.

Sealed tenders to be sent to the Chairman of the Company not later than the 12th day of June next, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
W. DUESBURY,
Manager.

Gas-Works, Cambridge,
May 5, 1893.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of COALS, COBBLES, or NUTS (about 110,000 tons per annum) for One, Two, or Three Years ending May 31.

Particulars and Form of Tender can be obtained on application to the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, the 3rd of June next.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane, Leicester,
May 4, 1893.

BUXTON LOCAL BOARD.

TENDERS FOR TAR AND LIQUOR.

THE Buxton Local Board invite TENDERS for the purchase of the surplus TAR and LIQUOR produced at their Works in Ashwood Dale, for One, Two, or Three Years, commencing from the 30th of June next.

Further Particulars and Forms of Tender to be obtained of Mr. G. Smedley, Gas Office, Buxton.

Tenders, endorsed "Tender for Tar and Liquor," to be addressed to the Chairman of the Gas Committee, and delivered not later than Twelve Noon on the 3rd of June.

The Board do not bind themselves to accept the highest or any tender.

By order,
JOSIAH TAYLOR,
Clerk.

Town Hall, Buxton,
May 20, 1893.

CORPORATION OF LANCASTER.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of GAS COAL, delivered, on the Gas-Works Siding, Lancaster, in such quantities and at such times as may be required during a period of One, Two, or Three Years, commencing delivery Aug. 1 next.

Sealed tenders, endorsed "Gas Coal," giving full particulars of the Coal offered, must be delivered to W. O. Roper, Esq., Town Clerk, Lancaster, on or before the 19th day of June next.

Forms of Tender may be obtained on application to the undersigned.

The lowest or any tender not necessarily accepted.

CHAS. ARMITAGE,
Manager.

Gas-Works, Lancaster,
May 25, 1893.

THE INCORPORATED

Gas Institute.

THE THIRTIETH

ANNUAL GENERAL MEETING

OF THE MEMBERS

WILL BE HELD ON

Tuesday, Wednesday, and Thursday,

the 13th, 14th, and 15th June, 1893,

AT THE

CITY HALL, VICTORIA STREET, BELFAST.

THE CHAIR WILL BE TAKEN BY THE PRESIDENT,

DENNY LANE, Esq., M.A., J.P.

THE BENEVOLENT FUND.

The Annual General Meeting of the Donors and Subscribers to the Benevolent Fund will be held on Tuesday, 13th June, at 5 o'clock p.m.

F. G. BURFIELD, Secretary.

3, *Victoria Street, Westminster, S.W.*

COUNTY BOROUGH OF WEST BROMWICH.
(GAS DEPARTMENT.)

TO COLLIERY PROPRIETORS.

THE Gas Committee are prepared to receive TENDERS for the supply of 22,000 tons of best screened GAS COAL, for use at their Works, Albion, West Bromwich; also from 200 to 300 tons of SCOTCH or other high-class CANNEL COAL.

The Committee do not bind themselves to accept the lowest or any tender; and they reserve to themselves the right to divide the contract between several Firms.

Forms of Tender may be obtained upon application to Mr. W. Littlewood, Manager of the Works.

Sealed tenders, properly endorsed, to be addressed to me not later than Thursday, June 15.

By order,
THOS. HUDSON,
Secretary.

Town Hall, West Bromwich,
May 25, 1893.

BOROUGH OF DEWSBURY.

THE Lighting Committee are prepared to receive TENDERS for the supply and delivery at their Gas-Works, Savile Town, near Dewsbury, of the following quantities of best screened GAS COAL during a period of One, Two, or Three Years, commencing on the 1st day of July next:—

First Year . . .	17,000 tons.
Second Year . . .	17,500 tons.
Third Year . . .	18,000 tons.

Tenders must specify prices for delivery by Road, or by Water, or by Rail, and be made on Forms to be had on application to Chas. A. Craven, Engineer and Manager, Savile Town Gas-Works, Dewsbury, from whom any further information can be obtained.

Sealed tenders, endorsed "Tender for Gas Coal," to be sent to me not later than Saturday, the 10th day of June next.

The Corporation do not bind themselves to accept the lowest or any tender.

E. MAWDESLEY,
Town Clerk.

Town Clerk's Office,
Town Hall, Dewsbury.

BRIDGNORTH CORPORATION GAS-WORKS.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee are prepared to receive sealed TENDERS for the supply of GAS COAL, including carriage to the Bridgnorth Railway Station, as follows:—

(1) For One or Two Years, determinable at the option of the Gas Committee at the end of the first or second year.

(2) For One Year only.

Evidence as to quality of Coal must accompany each tender.

Quantity required: About 2000 tons per annum, in proportionate deliveries as directed.

The contract to commence at the end of July.

Sealed and marked tenders must be sent to the undersigned not later than Saturday, the 10th of June.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
J. H. COOKSEY, Town Clerk,
Secretary.

Bridgnorth, May 27, 1893.

HAYWARDS HEATH GAS COMPANY, LIMITED.

GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 1500 tons of GAS COAL, deliveries of which are to commence the first week in July, 1893, and to be continued in such quantities as they shall from time to time require until the 30th of June, 1894.

The Coal required is to be unscreened, and be delivered in Trucks (free) at the Haywards Heath Railway Station, L. B. & S. C. Railway, either from the South Yorkshire or Durham Coal-Fields.

Payments, net cash monthly.

Tenders are to state the names of the Pits from which the above description of Coal will be supplied the same to be fresh wrought and free from Slate, and to the entire satisfaction of the Company's Manager.

The Board have no special Form of Tender, and do not bind themselves to accept the lowest or any tender.

Tenders are to be received by me on or before the 15th day of June next, and endorsed "Tender for Gas Coal."

ARTHUR H. CÆSAR,
Secretary.

85, Gresham Street, London, E.C.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

SALE BY TENDER OF £15,000 NEW STOCK, 1882.

IN pursuance of the Tottenham and Edmonton Gas Act, 1882, Notice is hereby given that it is the intention of the Directors to SELL BY TENDER £15,000 of NEW STOCK of the Company, to be paid up in full on or before the 31st of July next, after which date Dividend will commence to accrue, such Stock being the second portion of additional Capital authorised to be raised by Resolutions passed at an Extraordinary Meeting of the Proprietors, held on the 22nd of February, 1890, under the powers of the above-mentioned Act.

The Dividend on the Stock will be calculated half yearly up to the 31st of December and the 30th of June in each year, and will be paid by warrant issued within one week following the Half-Yearly Meeting of the Company, usually held on the last Saturday in February and August respectively in each Year.

A Deposit of 10 per cent. of the nominal amount of the Stock tendered for must accompany each tender.

Any amount not being less than £5, or a multiple thereof, may be tendered for; and the Stock will be registered in the Company's Books in the names of Allottees or their Nominees free of expense.

The minimum price below which no tender will be accepted has been fixed at One Hundred and Fifty Pounds Sterling (£150) for each One Hundred Pounds (£100) of Stock.

Particulars and Conditions of tender may be obtained on application to this Office; and sealed tenders must be sent in not later than Four o'clock in the Afternoon on Friday, the 16th day of June next.

By order of the Board,
JAMES RANDALL,
Secretary.

Offices of the Company:
Willoughby Lane, Tottenham,
May 5, 1893.

NOTICE OF REMOVAL.

TO GAS ENGINEERS & MANAGERS.

CROWTHER BROS.,

Contractors for Retort Setting. Erection of Gas Apparatus, and General Repairs, have removed from 384, Mile End Road, to

152, TEVIOT ST., ST. LEONARD'S ROAD, POPLAR, LONDON, E.

HOLMSIDE GAS COALS.

(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16½ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over

400,000 Tons per Annum.

Full particulars on application to

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

FAMOUS LEESWOOD

"CURLEY CANNEL."

YIELD: 15,306 CUB. FT. PER TON OF 30·62-CANDLE POWER.

SMOOTH CANNEL.

YIELD: 12,321 CUB. FT. PER TON OF 21·321-CANDLE POWER.

PRICES AND PARTICULARS OF

MESSRS. S. CHANDLER & SONS,
LEESWOOD COAL AND CANNEL MINES,
PONTYBODKIN, nr. MOLD, NORTH WALES.

NIDDRIE CANNEL

A FIRST-CLASS CANNEL COAL,

Yielding a large volume of rich Gas, and fully 60 per cent. of first-class Coke.

FOR ANALYSIS, PRICE, AND ALL OTHER PARTICULARS, APPLY TO

The Niddrie & Benhar Coal Co., Ltd.,
4, York Buildings, Queen Street,
EDINBURGH.
Telegrams: "BENHAR, Edinburgh."

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY
FOR ENGINEERS.

STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

London Office:
90, CANNON STREET, E.C.

CAST-IRON PIPES

FOR GAS AND WATER.

Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES

FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."

WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

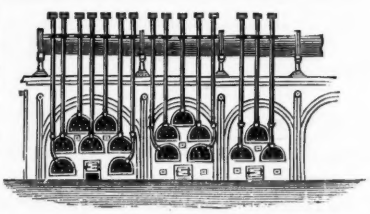
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY

Strongly recommended where EXCESSIVE HEATS have to be maintained.

DEMPSTERS'



RETORT-SETTINGS,

RETORT-FITTINGS,

ELLAND.

PRICE **5s. 6d.**, *POST FREE.*

THE ROYAL MARRIAGE.

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FIRE-CLAY & BRICK WORKS,

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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

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BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

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CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles
Coke per ton	1,301·88 lbs.

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Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
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WORKED BY THE

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OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. PATTINSON, Public Analyst for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a working Analysis made of these Coals by the Falmouth Gas Company:—

[COPY.]

FALMOUTH GAS COMPANY,

Offices: *Church Street, Falmouth, January 25th*, 1893.

Messrs. the

WEARDALE IRON & COAL COMPANY, LTD.,

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GENTLEMEN,

From the Cargo of **THORNLEY GAS COAL**, received early this month from you, I have Carbonized at these Works, during a period of thirteen consecutive days, 151$\frac{15}{20}$ tons of the Coal, mixed with 9$\frac{5}{20}$ tons of Cannel Shale (or about 6 per cent.)

The Make of Gas during the above period was 1,624,000 cubic feet.

The whole of the Gas was made from four beds of sixes (24 mouthpieces); each charge being of six hours' duration.

Gas made: 1,624,000 cubic feet.

Coal Carbonized: 151$\frac{15}{20}$ tons.

Cannel Shale: 9$\frac{5}{20}$ tons.

Make per ton of Coal and Cannel Carbonized: 10,082 cubic feet.

Coke per ton (of good quality): 13$\frac{1}{4}$ cwt.

The ILLUMINATING POWER averages from 11 daily tests, **16·54 CANDLES**, which was ascertained by burning the Gas at the rate of 5 cubic feet per hour in a certified Letheby Photometer, fitted with a Standard Argand, each Candle consuming 120 grains of Sperm per hour.

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J. WM. BUCKLEY,

Engineer and Manager.

For Price, &c., apply to the

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MADE WITH FOUR BLADES,

To pass 300,000 Cubic Feet per Hour, with or without Engine combined.

IN USE AND ON ORDER FOR OVER 100 WORKS,

AND EQUAL TO

5,340,000 CUBIC FEET PER HOUR.

SPECIAL ADVANTAGES:—

The Four-Blade Exhauster **PASSES 50 PER CENT. MORE PER REVOLUTION** than any One or Two Blade Exhauster.

It takes 27 per cent. less power than any Two-Blade Exhauster.

It gives a steadier Gauge than any other Exhauster.

One of our 150,000 feet per hour Patent Four-Blade Exhausters passes continuously **180,000** cubic feet per hour, driven by a **12-INCH STEAM CYLINDER.** No other Maker can give a similar result.

Model of Patent Exhauster sent for inspection.

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Washer-Scrubbers, with **WOOD CLUSTERS**, and Tar Extractor combined.

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Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.
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Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.
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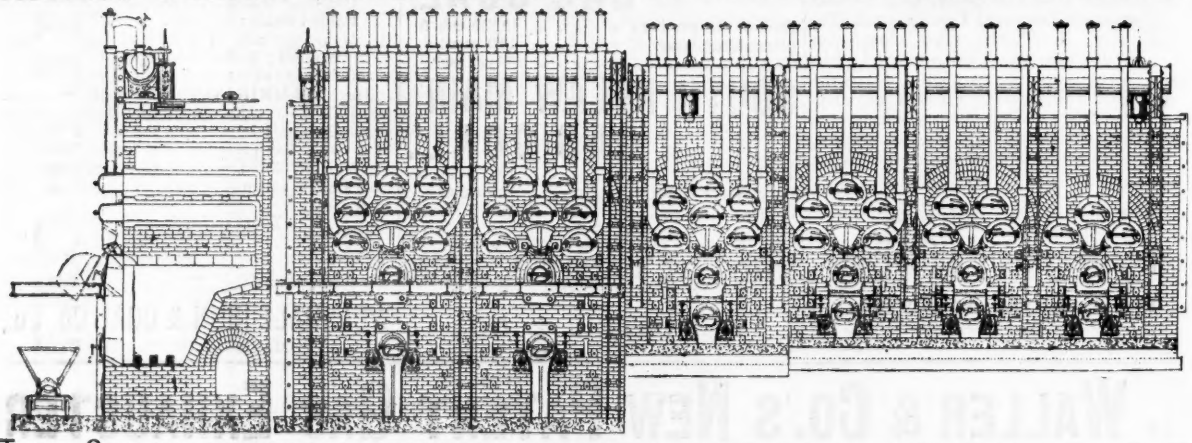

THESE SETTINGS ARE ADAPTED TO THE REQUIREMENTS OF ALL GAS COMPANIES AND GAS CORPORATIONS, AND HAVE ALREADY BEEN EXTENSIVELY ADOPTED. THEY ARE ERECTED UPON BOTH THE WORKING-STAGE AND SHALLOW-CHAMBER SYSTEMS, AND EQUALLY SATISFACTORY RESULTS ARE GUARANTEED IN BOTH CASES.

THE SETTINGS HAVE ATTAINED TO A MEASURE OF SUCCESS AND POPULARITY QUITE UNEQUALLED BY THAT OF ANY OTHER WITHIN THE SAME SPACE OF TIME. THE WORKING RESULTS OBTAINED, AND THE GENERAL SATISFACTION GIVEN, ARE DECLARED IN EVERY CASE TO EXCEED, AND IN MOST CASES CONSIDERABLY EXCEED, THE PATENTEE'S GUARANTEE. THE CONSTRUCTION AND WORKING OF THE PATENT PRODUCER AND THE PATENT CHARGING APPARATUS FOR SAME ARE ABSOLUTELY UNIQUE AND UNRIVALLED, AND ARE THE DELIGHT OF EVERY STOKER; WHILE IN EVERY OTHER PARTICULAR THEY SECURE THE HIGHEST RESULTS ATTAINABLE BY ANY REGENERATIVE SYSTEM, AND AT A MINIMUM OF COST.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings, or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stewart Street, Shawlands, Glasgow; J. E. FISHER, Stourbridge, and from R. F. HISLOP (son of Patentee), Gas-Works, Paisley.

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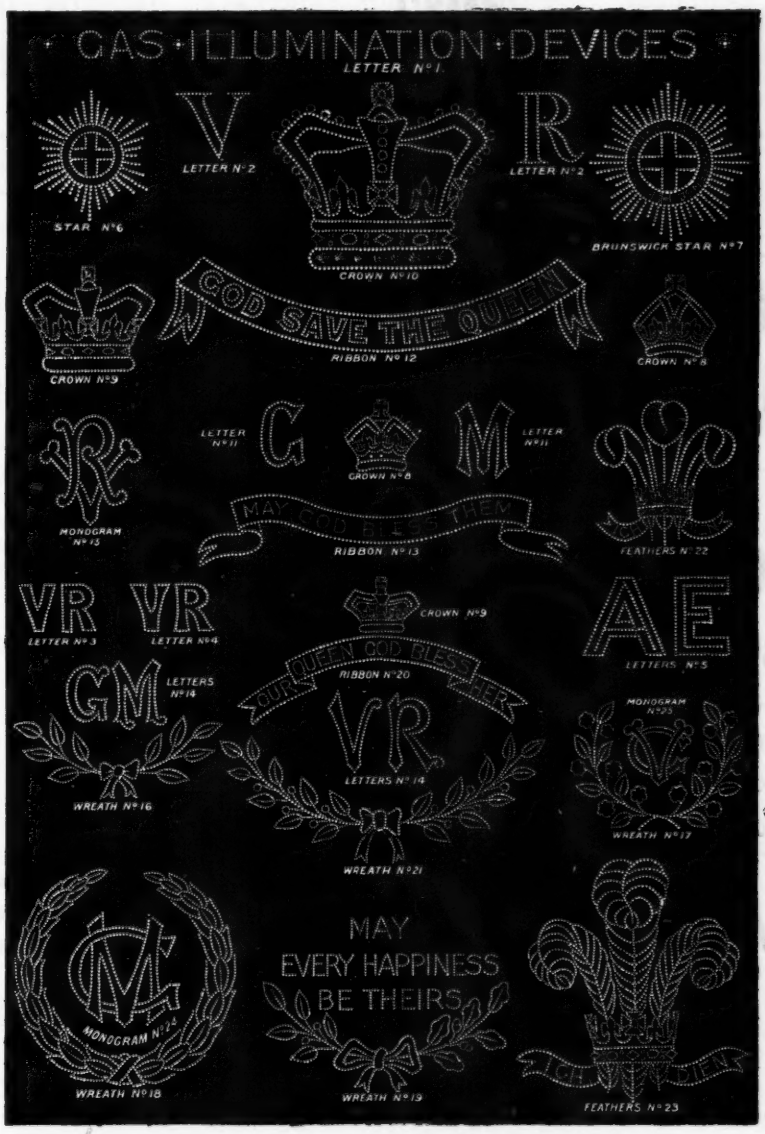

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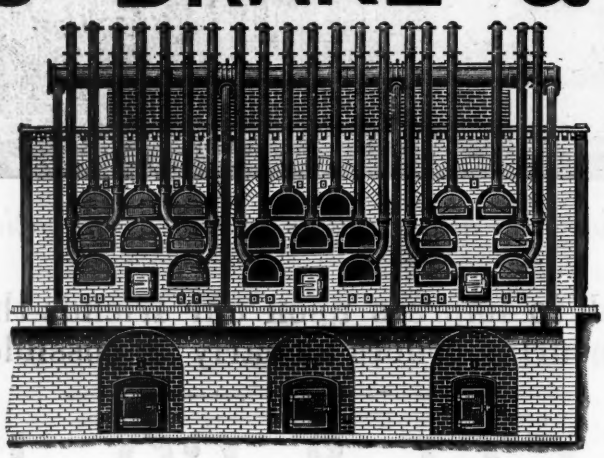

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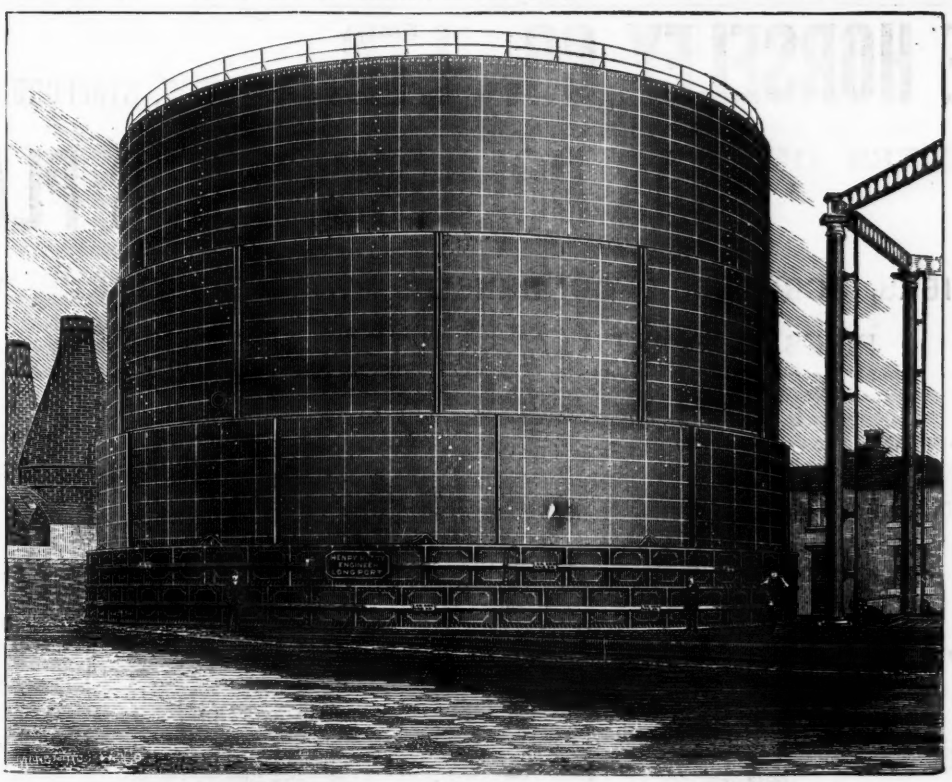

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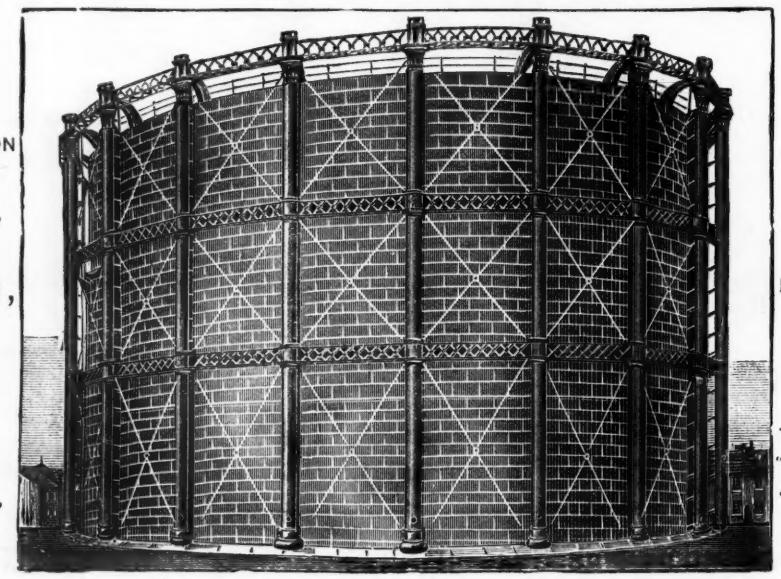

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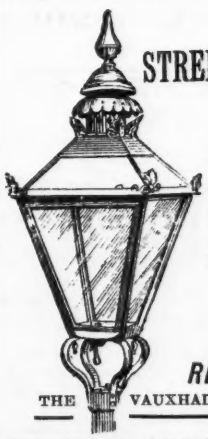

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"During last winter we used them at all the centres where we cooked by gas; and we shall continue to do so until we find they are superseded, which I consider unlikely."

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[See also Advt., p. 982.

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